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Lighting Under Difficulties. Any superintendent of a central station who feels discontented with his lot should read the notes we publish this week, of electric lighting in South America, and be comforted. Gas companies are hostile here of course, but it is not necessary to hire armed bravos and masquerade as a walking arsenal to circumvent their emissaries. Still, possibly there are those to whom a snap shot at a gas man would not be unwelcome.

Ancient Electric Welding. IT sometimes seems as if even in electricity there were nothing new under the sun. Now comes a brief reference to welding done by Wilde's machine nearly twenty years ago. To weld a tang to a file was certainly a successful experiment for those days, and shows how prompt in seeing applications were those early workers in dynamo electricity, whose pioneering labors we are apt to neglect in the enormous developments of later years.

Telephone Engineering. IN his interesting paper before the New York Electrical Society, reported elsewhere in this issue, Mr. J. J. Carty calls attention to some of the problems in modern telephony. There are few branches of electrical work that involve more important theoretical questions and more intricate practical details than telephony, and it is a pleasure to have the subject discussed by one so thoroughly familiar with it. With the modern long distance telephone has come a great increase in the importance of the instrument and the magnitude of the engineering work required.

Electric Lighting in Canada. THE report we publish of the progress made by our Canadian friends, contains some very interesting facts. It is instructive to notice some of the differences between their practice and our own. Belting direct from engine to dynamo does not seem to have found favor with our more northern neighbors; so that the large slow-speed engine appears to be more extensively used in the Dominion than here. It is worth noticing, too, that Canadian engineers have taken full advantage of available water power. As to the electrical systems used, there are wide differences between the distribution of the spoils there and here, as will be seen from the tables. Some of the machines little used here seem to have been pushed across the border with commendable vigor.

Mayor Grant and his Little Hatchet. A RECENT session of the Board of Electrical Control was enlivened by a little sputtering on the part of his Honor the Mayor. This time it was the slowness of the electric light companies in using his pet high-priced subways that aroused his indignation. He scolded vigorously and threatened to take the warpath with his official axe. Somehow his Honor seems to have a fondness for dark streets, possibly out of regard for some of his constituents. His previous efforts in this direction have made him so many warm friends among electricians that one would suppose he would be quite happy and satisfied. And we do hope that he will be able to exhibit some of the virtues of the Father of his Country without resorting to an imitation of the cherry tree episode at the expense of the public peace and comfort.

Life of Incandescent Lamps. REPORTS come from time to time of lamps that have burned many thousand hours, and such facts are very encouraging to every one interested in electric lighting. But in nearly all these accounts one very important bit of information is omitted—the actual voltage at the lamp in question. It is very well known that lamps burn out quickly if worked above their proper pressure, and last unusually long if operated a little below the normal voltage. It would add very much to the interest and value of the statistics on long-lived lamps if the exact working voltage were given in each case. Notes on the life of the series lamps used on arc circuits would form a useful addition to our knowledge of the subject, and we trust that some of our correspondents who have had experience with such lamps will come to the front with information on this point.

The Vagaries of the Patent Office. WE are pleased to find in a communication published this week that the Patent Office has at least a tolerable defense. We think that our correspondent is probably correct in laying the blame for many queer mistakes on overzealous patent attorneys. So few inventors prosecute their own claims that they are hardly an important factor in the question. As nearly as can be judged, many of the extraordinary claims allowed arise in the juggling process that succeeds the formal application. As regards that historical transformer case, if the impossible and impracticable were to be eliminated from the patents issued, their number would be fewer than at present. There may be an excuse for unimportant antiques successfully running the gauntlet of the office; but very little can be said for the practically identical claims that escape notice. To say the least, this is gross carelessness on the part of those who should know better.

La Gymnote. THE recent performances of this remarkable submarine boat are such as point out quite plainly the tremendous applications of electricity to modern warefare. She has proved to be most formidable. Manœuvered with the greatest facility and speed, with a gyroscope for her compass, and the silent motor to drive her, she slides through the water without even a wake of rising bubbles to mark her progress. It would be a daring commander who would risk his vessel in a harbor where two or three of these steel-clad sharks were lying in wait. Against such an invisible foe guns are powerless and torpedoes of little avail. One of them could lurk in the shallow water just off the channel and discharge one torpedo after another, or slide alongside the coming foe and sink her with a single discharge at short range. Our own naval authorities should look into this matter and see to it that we do not fall behind other powers in the products of modern ingenuity.

A Look into the Future. PROF. THOMSON'S brief lecture published in our columns this week is immensely suggestive. One cannot glance over it without reading between the lines the promise of marvellous improvements, of far-reaching changes in methods, and of prodigious discoveries. It is pleasant to find one so competent to discuss engineering problems speaking so confidently of the near approach of electrical express trains. There are still some faint hearts in the ranks, still some overzealous enthuiasts who would storm the works that can only be taken by a regular siege; but the forces are being marshalled, the guns trained, the parallels daily worked nearer, and one line of defences after another must surely fall. Think a moment, and see what a hundred miles an hour really means. Starting from New York, it means Philadelphia for a jaunt before breakfast, Boston a pleasant morning's trip, Chicago an easy night's run. And this is only one of the brilliant probabilities that is brought to our notice.

The New Ayrton & Perry Instruments. THE twisted strip voltmeter and ammeter, which we describe elsewhere in the present issue, were briefly referred to by the inventors some time since; but some months of testing and careful investigation have been spent in perfecting them. The principle on which these voltand am-meters work is an exceedingly interesting one, the more so as it possesses numerous practical advantages. It is a very desirable thing to have measuring apparatus that will not be itself affected by magnets and will not disturb neighboring instruments. These valuable properties are possessed by the ingenious device developed by Ayrton & Perry. The range of readings covered by these voltmeters and ammeters is excellent, although, as in the magnetic instruments of the same inventors, the practical scale does not begin quite at zero. A very important advantage of the new type is the ability to measure direct and alternating currents indifferently, a power which it shares with very few competitors. We hope soon to see these instruments on the market in this country.

Air Resistance at High Speeds. THE paper by Mr. O. T. Crosby, which we publish this week, is a most valuable addition to our knowledge of a much discussed and misunderstood subject. From the time of Newton it seems to have been tacitly assumed that the resistance of the air to a moving body varied, if not as the square of the velocity, then as some still higher power. Experiments with projectiles have been numerous, and have furnished a large and discordant variety of empirical formulæ, while some tolerable results have been obtained at low speeds. Mr. Crosby has extended engineering speeds until they meet and develop the lower limit of ordnance speeds. His experiments are admirably concordant, and result in establishing very distinctly a strictly linear relation between velocity and air resistance at speeds of from 10 to 130 miles per hour. At the higher railroad speeds the difference between the real air resistance and the values derived for it from the usual formulæ is very great, and it is interesting to see Mr. Crosby's results explain this discrepancy. At the very high speeds that we may expect to see obtained by the use of electricity, this factor of air resistance becomes important, and an exact knowledge of its nature is indispensable to progress. The theoretical questions raised in the present paper are of great interest, and the practical results are of immediate and distinct value. The author's suggestion as to the cause of the differences between his own observations and those at different speeds is particularly interesting, and is rendered very plausible by the known phenomena of water resistance to vessels in motion.

Piratical Protection. ELECTRICAL manufacturers have not made any extensive preparations for a glad thanksgiving festival on the possible passage of the McKinley tariff bill. On the contrary, they are engaged in sad, though patriotic, efforts to find something to be thankful for in the text of that remarkable document. To be sure, they might contemplate the rates levied on their various products intended to discourage the foreign competition that they have no occasion to fear. They can, perhaps, wrench a morsel of satisfaction from the fact that electricity is not made the subject of an internal revenue tax, as a product, like whisky, injurious to the human constitution when taken in excess. But for all this, they cannot quite understand how taxing their raw material will enhance their profits. Of course they are assured that protection is a great and glorious thing; but somehow, as they look ruefully at the price of copper, they fail to see how the glad effulgence of that kind of glory that pays 75 per cent. annual dividends on copper stock is to be reflected upon them. Nor do they, as yet, quite comprehend how the working man, whose interests are so dear to every philanthropic protectionist, is to be benefitted by lessening the profits of those who employ him. With an increased tariff on many things necessary to the growth of electrical manufactories added to the present intolerable burden imposed for the benefit of the copper ring, the feeling comes that it is time for the great allied electrical industries to assert their rights. The protection that is offered them is a mockery, such protection as one would expect from an amiable and avaricious brigand.

The Economy of the Locomotive.

BY DR. LOUIS BELL.

I am somewhat surprised to notice that the accuracy of certain statements of mine concerning the efficiency of the modern locomotive has been called in question, showing how widespread is the error that I have more than once endeavored to correct, of underrating the efficiency of the steam locomotive.

As an electrical engineer, and one who has gone on record as a firm believer in the value and efficiency of the electric motor for railway work, I should be pleased if the popular notions concerning locomotive efficiency were verified by the facts. As it happens, however, they are not.

In my Chicago paper on the subject of electric traction,* I made some allusions to the efficiency of locomotives, which I supposed would be well known to every professional man who had thoroughly informed himself on the question. It did not seem necessary, therefore, to go at great length into the literature of the subject. I am pleased, however, to dive into my note-books and furnish some additional information concerning the tests which seem so remarkable.

In a very elaborate paper, read and discussed before the American Society of Mechanical Engineers, and published in the proceedings of that body three or four years ago, the result of perhaps the most elaborate series of tests ever performed on a single type of locomotive is given in great detail. These experiments were tried with a Strong locomotive, and the result of them showed an efficiency that was exceedingly satisfactory. The tests were not under ideal conditions. On the contrary, they were made with a large and powerful locomotive, drawing a heavy train under all sorts of conditions, and at all sorts of speeds. The coal consumption was determined with exactness; the amount of water used was measured with great care; the power developed by the locomotive was obtained by a most elaborate investigation with indicators during the progress of the runs, so that the actual horse power developed cannot be a subject of question. The cards themselves were put in evidence before the meeting. The result of these tests was that which I stated in the paper I refer to. Some of the runs showed a consumption of coal below 4 pounds actually burned per indicated horse power hour. Most of them showed a coal consumption of between 4 and 5 pounds per horse power hour. The consumption of water was, in general, between 25 and 30 pounds per indicated horse power hour. Comparing these quantities, it will be seen that the evaporation secured in the boiler was 6 or 7 pounds of water per pound of coal consumed.

In the discussion that followed this paper not a voice was raised to doubt the results of the experiments. One of the well-known engineers present, however, rose to give the results of some tests made on a New England road with which he was connected. These referred to a locomotive having an ordinary valve gear. The results derived were of much the same character as those with the Strong locomotive, showing an efficiency nearly as good, the consumption of coal per horse power hour being, as before, from 4 to 5 pounds, and the consumption of water per horse power hour 25 to 30 pounds.

Wellington, in his admirable treatise on railroad location, gives as a good performance for an ordinary locomotive 4 to 6 pounds of coal per horse power hour, with an evaporation from the boiler of 6 to 8 pounds of water per pound of coal. To that treatise, and to the files of the London *Engineering* and the American *Engineering News*, I would refer any one who cares to go further into the performance of a machine that seems to him uneconomical.

Referring to foreign practice, we find similar results. A series of experiments tried in Russia about five years ago, reported in *Engineering* in September, 1886, show for the ordinary locomotive, worked at the practical ratios of expansion, a consumption of water from 27 to 29 pounds per indicated horse power hour. As I stated in a previous paper, the compound locomotive showed a consumption on the average of a little less than 25 pounds of water.

Compare, now, these results with those obtained from ordinary high-speed engines. In the Proceedings of the American Society of Mechanical Engineers for the past few years will be found several papers bearing directly upon the subject. In one of them Mr. G. H. Barrus, well known as an expert on the steam engine, makes so bold as to declare that in no case has he ever found less than 30 pounds of water per horse power hour used in the ordinary high-speed engine. Low-speed stationary engines with a Corliss valve gear, or its equivalent, give rather better results, and usually show a consumption of from 25 to 29 pounds of water per horse power hour.

It is very true that, theoretically, the locomotive is somewhat at a disadvantage. It has the simplest sort of valve gear; it is governed by throttling, and it does not give a very symmetrical indicator card. Nevertheless, the engine itself does give good economy—as good as can be obtained from the ordinary high speed engine; as good, in many cases, as will be seen from the figures just given and by reference to the places noted, as even the fine low-speed engines with complicated valve gear. The fact is, that although the locomotive is, in the respects I mention, theoretically defective, yet the great size of the cylinders and enormous horse power developed more than counteract these disadvantages. Other things being equal, better results are obtained from a very large engine than from a small one, and the ordinary locomotive develops a horse power far greater than any of the simple engines in use in power stations to-day, with which we should have occasion to compare it. That is the probable reason for its showing an efficiency greater than the average high-speed engine.

I think a study of the tests to which I refer, and any others of a definite and scientific character which one may chance to find, will make it clear that as an engine, the locomotive will give the indicated horse power hour on less steam than the usual high-speed simple engines used in electric light plants.

So far as the boiler is concerned, I have admitted that the results obtained with the locomotive boiler are not quite so good as the best which can be obtained from the stationary boiler. That is to be expected, but it is a fact tolerably well known that the average stationary boiler oftener evaporates seven pounds of water per pound of coal than nine or ten.

With reference to the statements I made concerning New York elevated railroads, they are upon the authority of Mr. F. J. Sprague, and are embodied in the paper which he read in 1888 describing the Richmond electric railroad, and published in THE ELECTRICAL WORLD of July 21 of that year. How far the facts have changed in the past three years I am unable to state.

It should be borne in mind that, to determine the efficiency of an engine, something more is necessary than to get off-hand statements of the coal consumed, and make a rough computation of the power that is probably required. The only tests that can give an accurate result are those wherein the horse power developed is ascertained exactly by indicator or by brake, and the water and coal weighed or measured. On these tests, and these only, I based my judgment as to the efficiency of the locomotive.

Poor figures for the locomotive are, I think, the result of an unfortunate experience. I have myself taken indicator cards from a Corliss engine of improved type that showed a consumption of more than 35 pounds of water per horse power hour, but I know very well that the engine was working under particularly bad conditions, and that such a result was to be expected. There are poor locomotives as there are poor stationary engines, but the best modern locomotives, developing as they do upwards of 500 h. p. by actual tests which have been plentifully reported in the technical journals and can be consulted by anybody who cares to do so, give an efficiency slightly greater than that obtained from simple stationary engines of the sizes ordinarily in use. When the locomotive is hard pushed by the rivalry of electricity, and development in the way of compounding becomes necessary, we shall obtain about the same efficiency from the compounded locomotive that we can obtain from a compound high speed engine. When it comes to the last resort, a stationary engine can gain a very great advantage by condensing. Aside from that, its somewhat superior efficiency rests particularly in a slightly greater boiler efficiency; but this, as reference to the journals will show, is by no means so great as is popularly supposed.

I quite agree in all that may be said against the reciprocating motion of the locomotive as opposed to the pure rotation of the electric motor. At best, the locomotive does not give anything like an equal effort through the revolutions of its driven wheels, while the torque on the electric motor armature is constant throughout its rotation.

I am fully convinced that the motor will find its way into a widespread application in traction on a large scale; but it will not hasten this much desired end if those of us who hope for it fall into the error of underrating the difficulties with which we have to contend. He is a very poor general who bases his hopes of a victory on underestimating the enemy's force, and, if electric traction is to be put in the prominent place we wish, it will be done by a constant, persistent effort, with an appreciation of every inherent difficulty to be overcome and every rival to be conquered.

* "On Electric Motors in General Railway Work," THE ELECTRICAL WORLD, March 22.

Successful Sea Trial of the Fiske Range Finder.

During the recent trial trip of the cruiser "Baltimore," with a board of inspection on board, the new Fiske range finder was given a thorough test, and the results were highly satisfactory. The targets were placed at ranges varying from 1,350 to 2,000 yards. The practice would have been entirely satisfactory for gun captains who had had two or three years' experience with their weapons, but, when it is considered that the captains of the guns were firing their first shots with the modern breech-loading gun, the results were very remarkable. The firing was declared by the ordnance experts on board to be closer than is ordinarily attained after months of practice. This result is due almost entirely to the range finder. The captains of the guns were enabled to know at any moment the exact distance of the target.

The range finders have now been used under all conditions of service. There is one on board the "Chicago" that differs somewhat in its make from that on board the "Baltimore." The reports from both, however, have given almost entire satisfaction. In addition to finding the distance of a target from the vessel the range finder was also used in determining the tactical diameter of the cruiser, and showed great accuracy. A board of officers has been appointed by Capt. Schley, composed of officers of the "Baltimore," to make further experiments with the range finder and to submit a report of what it accomplishes.

It is expected that the new instruments to be placed on the "Philadelphia" and other cruisers will be almost exact in their readings. Certainly the machine deserves the highest praise from both naval men and electricians.

Submarine Telegraphy.

BY W. E. IRISH.

Mr. Melhuish's paper on telegraphing without wire and with uninsulated wires passed through water and across rivers, etc., interested me greatly; as, with the exception of using the shields of cables, I had thirteen or fourteen

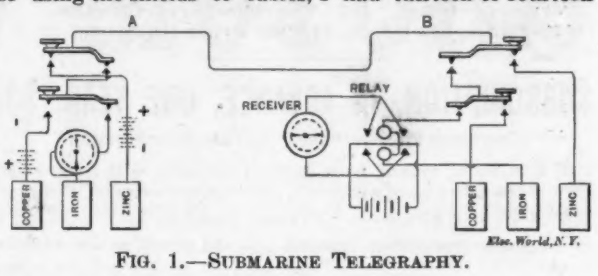


FIG. 1.—SUBMARINE TELEGRAPHY.

years ago experimented over the same ground (see THE ELECTRICAL WORLD, of Aug. 14, 1886).

For the information of Mr. Melhuish and others desirous of telegraphing across rivers, or maybe seas, by means of submerged uninsulated wires, I submit the following proved system, which they would no doubt find to answer their purpose: Run across the stream from point to point an iron wire, preferably covered in any manner to prevent its making metallic contact with other metal bodies, connecting the ends of the wire at each station through the axis and back stops of the sending keys and the receivers, to iron ground plates, as shown in Fig. 1. To the front stops of keys connect respectively a copper and a zinc plate buried some distance apart in moist soil, or placed in the river away from the line. All the plates should have considerably more surface area than whole line, and the plates of each station should have a higher resistance between them than between the plates of the different stations. When batteries are employed they are connected as shown dotted between the front stops and ground plates. The receiving instruments may be Bright's, Bell's, Neal's sounders, or single needles, but any and all would have to be specially wound unless batteries or a relay and local battery are employed.

At station A (Fig. 1) a single needle receiver is represented as working direct while at station B a recording instrument is represented as being operated by a local battery through the medium of a double-tongued polarised relay.

Experiments have led me to believe the best and simplest means for telegraphing electrically across an expanse of water without a wire is as shown in Fig. 2, where large copper and zinc earth plates are submerged on each side of the stream as nearly in line with each other as convenient, and with their greatest area exposed to each other. These plates are to be connected to their respective keys, and thence by the upper contact, when the keys are at rest, to the receiving instruments, which are grounded on their other sides to a second large plate of metal, but at considerable distance from the first. Two zinc plates are employed at one station and two copper plates at the other (Fig. 2). It will be seen that the front anvils of the keys

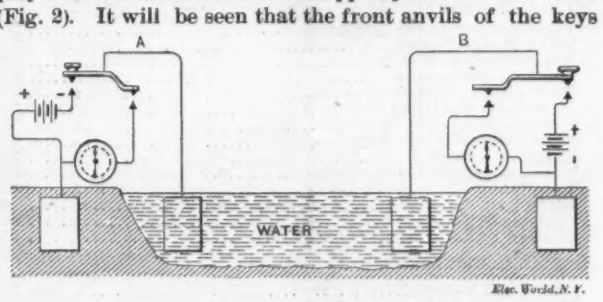


FIG. 2.—SUBMARINE TELEGRAPHY.

are connected to opposite poles of batteries, the other poles being grounded by the receiver ground plate.

It is important, if not essential, that the resistance between the ground plates at each station shall be higher than between the two submerged plates on each side of the water to be crossed.

Early Experiments in Electric Welding.

Mr. F. Higgins writes to the London *Electrician*, correcting an impression conveyed by that journal's remark, that "it does not seem to have occurred to any single soul, until three years ago, that if for the two carbons there were substituted two pieces of metal, and an end pressure applied, the two metal rods would become welded together."

Mr. Higgins says that he "and doubtless numerous other persons, saw electric welding done more than 20 years ago by a 'Wilde' machine. I myself," he adds, "welded a tang upon a file with but slight blistering at the junction. Mr. Wilde's patent, No. 1,412, of 1865, expressly mentions the application of his machine to welding, but he does not appear to have brought it into practical operation."

The Jersey City Electric Light Central Station.

We illustrate on this page the fine station of the Jersey City Electric Light Company. The company has had its plant in operation for about seven years, at first occupying a building on Bay street. Recently, however, it became necessary to move to better and more commodious quarters, and that building was abandoned for a new one at the corner of Wayne and Fremont streets.

The main building, which we show in Fig. 2, is a substantial structure of brick, and its dimensions, exclusive of the wing, are 60 × 140 feet. In it are contained the dynamo room, general office, and offices of the treasurer and superintendent; a store-room for general supplies, store-room for heavy supplies, repair shop, and room for employés. The boilers are situated in the wing. The boiler room is 60 × 120 feet, and admirably fitted up.

This is one of the stations in which a somewhat eclectic taste in dynamos is shown. It contains twenty machines, and they represent no less than four different makes. All dynamos are operated from a single line shaft. This line shaft is divided as seen in our cut, Fig. 3, into two sections, each operated by an individual engine. Twenty-eight boilers are distributed along this line of shafting, each of them fitted with a Hill clutch, so that the dynamos connected with them can be stopped at will.

The incandescent lighting department of the station not only includes machines of different makes, but both alternating and direct current machines. There are three Ft. Wayne Jenney alternators, each of a capacity of 1,000 incandescent lamps. There is also a 1,000-lighter Edison municipal dynamo. They are not required to work in harmony on the same circuit, but, so far as yet reported, live at peace within the station. The arc-lighting department contains three Ball 20-light machines, nine Ball 35-light machines, one American 50-lighter and three American 30-lighters.

The switchboard where these varied circuits are distributed is a very artistic one, 12 feet square, and rising to a height of 20 feet. There are two 10-circuit switchboards for the arc lights. The switches and appliances for six incandescent circuits, and all the necessary measuring instruments, besides dynamos and 100 cells of storage battery, are available, although they are not at present much used. Thirty one hundred incandescent lamps are operated by the plant, with plenty of room for increase, while the machine capacity is already 4,800 and the switchboard is equipped for handling not less than 9,600 lamps. Three hundred and thirteen arc lights are in use, with a total capacity in the plant for 430. The arc circuit contains 40 miles of wire, the incandescent circuit 12.

Power is furnished by Buckeye engines, bolted, as seen, directly to the line shaft. One of them is a 450 h. p., the other a 225. The boiler room has ample capacity for these engines and any reasonable increase. There are two Abendroth & Root boilers of 175 h. p. each, two of 150 h. p. each, and two of 100 h. p. each, so that whatever loss happens, the station is not likely to lack steam.

The furnaces are provided with three stacks, each 70 feet high, and the boilers are supplied with water by two pumps and an injector. The steam pressure is adjusted with an application of the Hoffman damper regulator to the boilers. Every effort has been made to make the plant an economical and efficient one in every detail of its equipment, and the success thus far met with goes to show that this care and attention to the minutiæ of the plant are well repaid.

Besides its present equipment, the company is making ready to furnish power to an electric street railroad, which will demand special dynamos.

The company is a pioneer in electric lighting in Jersey City and has had, throughout its seven years' experience, no small degree of success.

The officers of the company are: I. J. Struble, president; G. B. Wilson, secretary; F. L. Perrine, treasurer; and W. W. Titzell, superintendent.

Fig. 1 gives a glimpse of the engine room, showing one of the big machines ready for business.

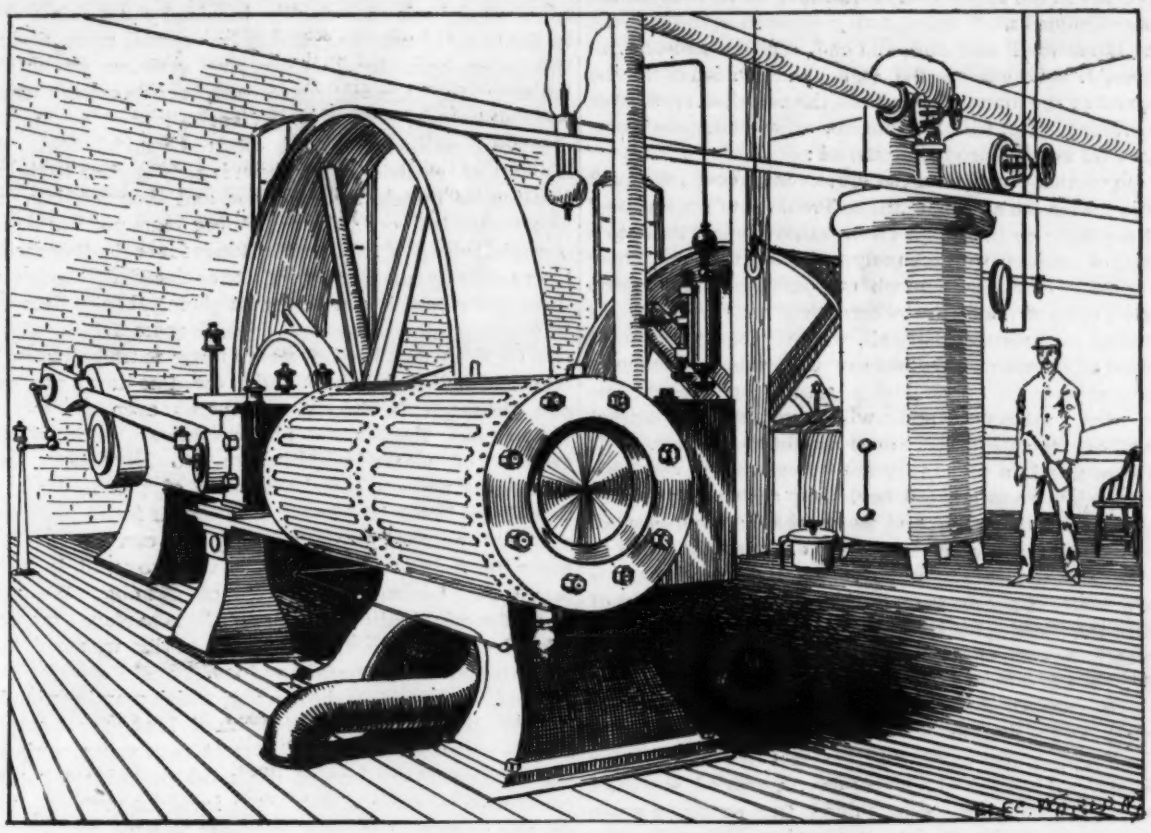
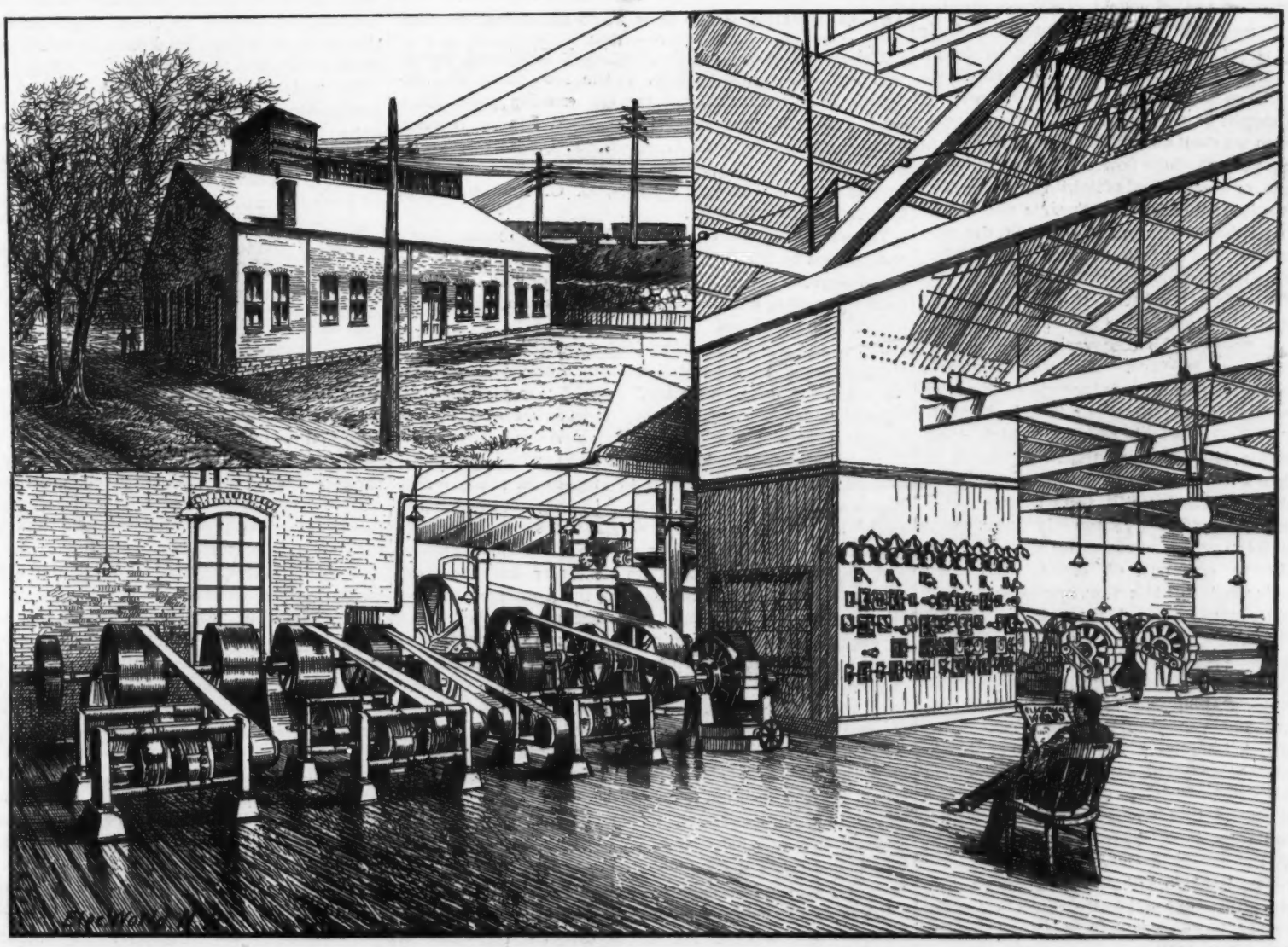


FIG. 1.—ENGINE ROOM OF THE JERSEY CITY ELECTRIC LIGHT STATION.



FIGS. 2 AND 3.—MAIN BUILDING AND DYNAMO ROOM OF THE JERSEY CITY ELECTRIC LIGHT COMPANY.

The Schiseophone.

This is one of the electro-mechanical appliances of which M. Lartigue, director of the French "Compagnie des Chemins de Fer du Nord." saw the merits when others were still turning a deaf ear to electrical inventors. Its object is to detect flaws and internal defects in rails, faults to which the rupture of rails and consequent accidents are mainly due. It is composed of a microphone and a telephone combined with a mechanical hammer or "knocker," and an induction balance, and by its action allows any internal defects in the materials to be accurately localized. During a number of experiments conducted before some of the high officials of the Northern Railway Company of France and a navy engineer delegated by the Naval Ministry, all the indications of the instrument proved absolutely correct, the rails, etc., on being broken, showing flaws at the exact spot indicated by the "Schiséophone.' It is intended to use the instrument for the verification of propeller shafts, but here its serviceability is as yet a matter of doubt. Should it prove efficient the Atlantic liners would be greatly benefited.

Professor Thomson on "The Problems of the Future."

The Thomson Scientific Club, of Lynn, Mass., celebrated on the 13th inst. the first anniversary of its formation. This society, although but of recent formation, is already very firmly founded upon an excellent basis, and those who responded to the toasts on the occasion of its first annual dinner included such well-known gentlemen as the Rev. Dr. F. T. Hazlewood and Messrs. C. J. Van Depoele, A. L. Rohrer, J. E. Randall and H. D. Sears. Mr. Randall, who presided at the dinner, introduced the principal speaker of the evening, Prof. Elihu Thomson, whose remarks seems to us well worth reproducing in full:

I am on the programme to speak on a subject which rather makes me a prophet, "The Problems of the Future," and anything on this subject necessarily reduces itself to a matter of opinion; we may predict and be mistaken. There are so many channels in which our sciences may develop that we cannot really say where they may run to. In electrical engineering, above all, we may expect the most marked advances. I need not say that this profession is the most modern of all, and a growing profession; one that has attracted and will continue to attract some of the greatest and brightest minds. It has grown up in a very few years. I remember very distinctly, when I was a small boy, that all we knew was related to the telegraph and its working; otherwise all was confined to some few laboratory experiments found in the books on natural philosophy. We all know how this is now vastly changed; there is scarcely a department of science that does not involve in it some electrical process, so greatly have the advantages of this branch been recognized. We find the process of evolution carried on, and the laying aside and forgetting of other ideas. We can see that the foundation on which we have built is gradually becoming more and more firm, so that the engineering problems can be worked upon to-day, provided we have our facts properly organized. Some five or seven years ago it was much a matter of guess-work to determine the problems that presented themselves in electrical work, and those who could guess the best would show the best results. Faraday, for instance, was able to guess nearer the truth than another man would arrive at by a long course of mathematical working.

The future still looks bright; we need have no fear but that there will be just as much room for work as in the past, and a continually expanding field. We see a number of problems not yet resolved, but some have reached their final solution. It is not a difficult undertaking to design dynamo-electric machinery of 300 to 500 h. p., which we regarded at one time as stupendous, when machines of 50 or 60 h. p. were thought to be very large. The day is certainly coming when we shall find dynamo machines up to thousands of horse power, where power is to be transmitted on a large scale, or a great deal of lighting is to be done from a central station. The ideal system is one whose mains will supply all that is needed, whether in the way of light, power or heat, and all from the same mains, without having a multiplicity of them.

It is much more easily told what will be the direction of advance with regard to construction and arrangement of machinery than to foretell the discoveries that may be made to change the face of things. We hope the day will come when we shall be able to produce electricity from fuel direct; a great engineering problem this, just how to do it—there are not enough facts at hand to work upon. There is the thermo battery, consisting, as it does, of nothing more than a series of metals properly connected and heated at their junctions; still, from this we obtain so little economy that the dynamo is very much ahead of it, though the present generating plant is cumbrous and liable to get out of order. There are some obscure effects when heat is thus applied to metals, causing slight currents to travel through the circuit, but these effects are too small to be of any practical use as at present obtained, the ideal arrangement being, as it were, a furnace that consumed the fuel and passed the energy along conductors to be used as required; if this came about steam engineering would receive its death-blow. We can imagine a locomotive that obtains its current by combustion at places along the track, or even on the engine itself. This would enable us to do a great number of things that we now find expensive; it would light our buildings more cheaply, and decrease the cost of traveling.

There is hope for such things, but I do not know whether they will come in our days; it is hardly possible for the growth to be too rapid, but a great deal of scientific work will have to be done first. In the near future railways will be run by electricity; not the small local roads, I mean, but really the large ones connecting cities, and there is no reason why we should not expect higher speeds than we can attain at present with our steam locomotives. There we have reciprocating parts, parts that must be put into motion, stopped and reversed continually, while in the electric locomotive we have the simple rotary motion, which is all we need, and which makes it possible accordingly to run at a much higher rate of speed. Although the steam locomotive has been very much improved, yet it can hardly compare with the economy of stationary engines, placed where they can have an abundant water supply for condensing purposes; we can, therefore, by employing stationary engines and electric roads, do away with a great deal of unnecessary weight, and the moving parts being symmetrical, we can attain a much higher speed, say a hundred miles an hour.

This would be a grand step forward, which would save us a great deal of time. It might even be possible to reach a speed of 150 miles an hour. I really think that if we could come back after another hundred years, this would be the speed of traveling; it simply depends upon finding the necessary method of applying sufficient power, and building the locomotives to suit, arrangements being adopted to keep the cars on the track.

There is another field—the electro-chemical field. We know that electricity has been largely applied to the extracting of metals from the ores, and their refining. As every chemical operation is nothing more nor less than a changing about of affinities or likings for each other among the particles composing bodies, and as electricity can govern these operations, it is evident that chemical operations can be conducted by electricity. There is room for investigation on this point, but it is a rare thing to find a man who is an accomplished chemist, and at the same time a practical and thorough electrician. I might even go so far as to say that since all operations such as the growth of plants are known to be based upon chemical reaction, and many of them can be reproduced in the laboratory, so in the far future our food may be produced by electricity. We can make grape sugar, for instance, and it may be that we could, in a certain sense, become independent of farming. We may *cause* the combination of elements to take place that *does* take place in the growth of plants, so that we could take water-power and manufacture food.

These are only ideas thrown out, which may be extended greatly—the getting of light without heat, for instance. That is undoubtedly one of the most engrossing engineering problems, and one of the most desirable things we could wish to come about. Our incandescent lamp produces a great deal of light, but there is some considerable heat, too; the arc lamp gives a larger proportion of light; we want to do without these low heat rays, and then we should obtain light at an exceedingly small cost.

These problems may or may not be resolved in our time, but we have the satisfaction of knowing that there is plenty of work to do in the future.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society was held at Columbia College, on the 15th inst. The folowing officers were elected for the ensuing year: President, Francis B. Crocker; vice-presidents, Joseph Wetzler, Francis Forbes, Dr. Otto A. Moses, T. C. Martin, G. H. Stockbridge, E. L. Bradley; secretary, Geo. H. Guy; treasurer, H. A. Sinclair; trustees, C. O. Mailloux, F. B. Crocker, Joseph Wetzler.

The subject of the evening, "Electrical Engineering," was treated by Mr. J. J. Carty, electrician of the Metropolitan Telephone and Telegraph Company, of this city, in a most interesting manner, and many new and important points were developed.

Mr. Carty protested against the reservation of the term "engineering" for the so-called heavy branches of electrical work. "There is nothing," he said, "to support such a position, as, although the telephonist is not called upon to deal with such works as a Brooklyn bridge or a St. Gothard tunnel, yet telephony is not so favored by gravity that its follower is not obliged to engage in some works which are heavy, and which entail the highest mechanical skill." A telephone office with six thousand subscribers should be provided with not less than 20,000 wires, and the 200 cables which are necessary for their extension from the switchboard to the basement of the building weigh 250 tons. The arrangement of these so that they can be effectively and conveniently handled is not by any means a simple matter, and further complications arise out of economical considerations affecting the room available. The difficulties of underground construction can be appreciated only by actual contact with the subject. Not only must the subways be kept ventilated and cool, as heat is inimical to all insulalation, but the question is thickly beset with grave chemical and mechanical issues. In view of its rapidly growing and important developments, the lecturer was of opinion that the question of telephone cables alone is worthy of a life study by the most ambitious student.

"A large switchboard, such as exists at Cortlandt street, New York, weighs 55 tons and contains 19,080 miles of wire, all of which is laid out according to an elaborate and intricate system not equaled outside of the human body."

Mr. Carty then proceeded to point out the many points of resemblance between the nervous system and the modern telephone exchange, and indicated the lines on which investigations, based on such an analogy, could be profitably prosecuted.

After discussing the question of the interferences caused in the telephone by railway and electric light circuits, the lecturer said: "The true theory of transpositions has never been published, and I do not know half a dozen men who could design a transposition system for a twenty-wire line from New York to Buffalo. The researches of Hertz, Lodge and others have an important bearing on the inductive action between telephone conductors, and they suggest a possible way out of the difficulties by some arrangement of dielectrics to control this action. The work of these experimenters should be closely followed by telephonists throughout the world."

A telephonist should be a good deal of a physicist; a familiarity with the physiology of the human voice and ear, and an intimate acquaintance with the science of acoustics are just as essential to him as a knowledge of electricity.

The lecturer considered that the phonograph is destined to play an important part in the telephone system of the future. At some time a phonograph may possibly be inserted in a telephone line to act as a sort of "talk meter,' and thus a record of all the conversation which goes over it would be preserved. "I once thought," said Mr. Carty, "of a curious use to which the phonograph might be put, that is, in transmitting speech through one of the existing ocean cables. I have no doubt that a cable could be designed which would enable us to talk direct to Europe. In such a cable the idea would be to have the capacity and resistance as low as possible. Perhaps if there was a cable ten feet thick we might talk through it. With the present cables signals are transmitted so slowly that before one telephone vibration reaches its destination another is piled in on top of it and confusion is the result. Now, my idea was to first speak into a phonograph and then turn the cylinder at a speed no faster than the cable can take care of the impulses; and to have at the other end a phonograph also revolving slowly (but not necessarily synchronously) upon which a record would be made. This second cylinder could then be revolved at the proper speed, and if all went well, the transmission of speech through an existing ocean cable would have been accomplished. It has been estimated from a microscopic examination of the word "Hello" on a phonograph cylinder, that it contains sixteen thousand indentations. If this is true, it would be quicker to send the phonograph cylinder by mail than to rely upon the cable."

Another instrument which must some day form an important part of telephone systems is the radiophone of Prof. Bell. By this wonderful instrument it is possible to telephone between distant points without a wire, the impulses being conveyed by the ether.

The lecturer drew attention to a singular feature of the possibilities of the long distance telephone service, viz., its probable effect upon the language of the country by preserving its uniformity in different sections where otherwise the tendency to form local dialects would naturally assert itself.

He said that though the telephone has never been used in a great war, it is capable of military application, perhaps not so important, but not less unique than that of times of peace. A short time ago General Manager Hall, of the Buffalo Telephone Company, assembled in less than half an hour the entire Board of Trade of that city to attend an important meeting which could only have been called by the aid of the telephone. This points to the value of the telephone in the mobilization of the various State Militia organization in time of war with unprecedented dispatch.

Board of Electrical Control.

The Board of Electrical Control had a lively session on the 14th inst. An emphatic protest was entered by the Commissioner of Public Works against the delay in laying the subways, by which the work of paving the streets of the city is being seriously delayed. Commissioner Ridgway said that the applications of the electrical companies had in many cases been withdrawn and new ones substituted, and so soon as the companies had really decided what they wanted, which would probably be within a week, matters could be pushed on.

Mr. Cohen, on behalf of the Subway Company, said that the East River company had not filed the required bond for ducts in the subway. Ex-Judge Kelly, who represented the company in question, expressed his willingness to provide satisfactory securities, but said he did not want to be imposed upon by the excessive rates of the American Security Company or otherwise. Mayor Grant became wroth, and threatened to send an order to cut down the wires if there were any further delay. After a long discussion as to whether the companies who wanted ducts in the subways should be compelled to place applications for the same forthwith, or allowed to do so later, it was decided that the companies should be given two days for their decision, after which the Subway Company would push on the work. Dr. Wheeler reported the locations in which trouble had arisen from steam-heating pipes, and stated that the steam heating company had given their assurance that all defects should promptly be remedied.

The Board met again on the 16th inst. A letter was read from the Police Department, in which complaint was made that the Consolidated Subway Company had refused to give them a duct for their wires. After some discussion the matter was referred to the expert and the engineer, to report on the 19th.

The United States and other electric light companies withdrew the applications they had already put in for ducts, for the purpose of presenting revised applications at the next meeting of the Board.

Electricity in South America.

According to the correspondent of an English journal, electric lighting, and especially the use of transformers, is rapidly gaining ground in South America; but the advance is subject to some peculiar annoyances:

"Spring is now beginning, and the street boys have begun their usual games, slinging, aiming stones at the porcelain insulators on the supports of the leads, kite flying, etc. It is needful to keep a sharp eye on the primary leads. Three men go about all day armed with long poles in order to knock down kite-tails from the leads."

Of still greater interest is the subjoined extract from another report from Montevideo:

"We must watch lest the lamp-lighters of the gas company, who, from intelligible reasons, are the sworn foes of the electric light, do some mischief. There are even in our own staff some men who, from ill-will, seek to play tricks on their fellows. For half the town I have thirty men in this service, as well as some secret inspectors, armed with knives, who look out for the mischief makers. I myself often range the streets by night, accompanied by my first official, with loaded revolvers in our pockets. The chiefs of the wire and lamp inspectors are on horseback, as also myself and my chief official, and as soon as any mischief begins we gallop up from all sides."

At Buenos Ayres an installation is in course of erection with two alternating current machines of the type A_8, each for 320,000 watts. The electric machines and transformers, as well as the steam engines, have been already supplied, the former by Ganz & Co., of Buda-Pest, the latter by the Machine Company of Brünn. Both the steam engines (of 600 h. p. each) and the alternating current machines make 125 revolutions per minute, and are in direct connection, so that the magnet wheel of the alternating current machine forms the fly-wheel of the steam engine.

At Mercedes a transformer installation for lighting the town has been erected. An alternating current machine of the type A_7 for 160,000 watts is here in use. It is driven by means of a band by an engine of 300 h. p.. supplied by Ruston, Proctor & Co , of Lincoln. A second engine is to be procured by way of reserve.

In Brazil the transformer system is being worked by an electric company at San Paulo. It was founded in 1887 under the style "Marques Monthe y Ca," and wished to begin by erecting a large transformer installation at San Paulo. But the slender means of the company did not permit the completion of the works which they had begun. They had to confine themselves to the erection of a small continuous current installation, driven by a locomotive for lighting up a limited district of the town. Last year the company was reorganized with an accession of fresh capital, and the undertaking, thus strengthened, adopted the name Companha Luz Electrica de San Paulo, and is occupied with the erection of two electric works at San Paulo and Casa Branca.

The installation at San Paulo is for the present equipped with an alternating current machine of the type A_8, of 50,000 watts and a corresponding number of transformers, the latter inclosed in iron cases and fixed on wooden supports. The motor power is furnished by a Westinghouse engine of 80 h. p.

At Casa Branca there is used an alternating current machine of the type A_3 (30,000 watts), driven by a "Colonial" steam engine by the firm Tangye, Limited, of Birmingham. Here, the transformers are placed in iron cases on wooden supports.

Both at San Paulo and Casa Branca wood is used as heating material in the installations. In Brazil the competition of the electric light with gas is much facilitated by the high price of gas coal, while wood for fuel can be very cheaply procured from the primitive forests. Insulated aerial leads are very generally used.

Some Very Neat Push Buttons.

As electric bells and annunciators have grown in favor and have been more widely distributed, the push-button that replaced the old fashioned bell pull has undergone a certain process of evolution. The big conspicuous buttons have given place to altogether neater forms, and we show herewith a group of push-button appliances that in compactness and unobtrusiveness leave little to be desired. Messrs. Edwards & Co., of New York, are the makers. Fig. 1 shows a pigmy button that is admirably fitted to sink in woodwork. The only part of it that shows is a narrow rim of polished brass less than half an inch in diameter surrounding the black push. The connections are shown in the rear of the button. They are separated by insulated washers and the wires are slipped under the two nuts.

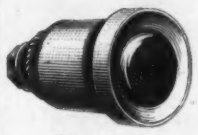


FIG. 1.

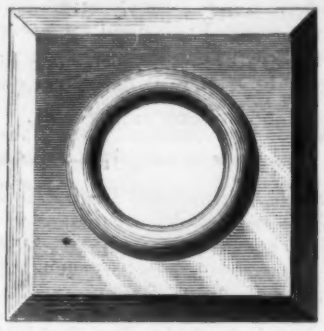


FIG. 2.

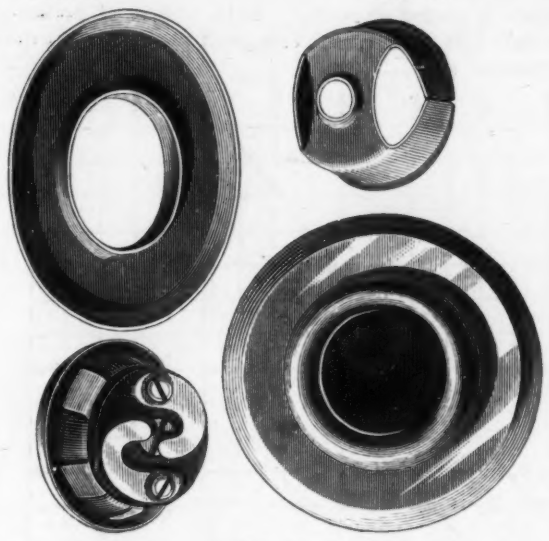


FIG 3.
SOME NEAT PUSH BUTTONS.

Figs. 2 and 3 show a universal push button with the separate parts that belong to it. The push button itself is shown in Fig. 3. It is but little larger than the other. It is used alone or cased in the iron sheath shown according to the material in which it is set. If it is wished to be very inconspicuous the button alone appears, surrounded by the narrow rim. For other cases the round and square polished brass washers shown fit tightly over the button proper and present a very neat appearance.

Special Rails for Street Car Service.

As electricity has gradually come to replace horses as a motive force for street railways, it has been necessary to pay more and more attention to the character and quality of the roadbed. As a rule, electric roads operated on old horse railroad tracks meet with more or less trouble, unless these have been laid with unusual care. An electric car, with its great weight and high speed, requires heavy rails and a well ballasted bed. The result of this need has been the development of various special contrivances for securing stability and strength in street railway construction.

The cuts presented show various forms of special and heavy rails now being manufactured by R. T. White, of Boston, for modern heavy street railway work. The solid head of the rail allows a large amount of wear before the flange of wheel can ever come to the surface of the rail.

Our cuts show the box form of chair that is specially adapted for rails of the channel iron kind as shown in the cuts, a shape that is in very extensive use.

Fig. 2 shows the jointed chair with the central box, having bracket projections to secure a long bearing surface for the rails to rest upon.

These improved rails and settings are designed specially for the heavy city work required, now that electricity is becoming the favorite motive power.

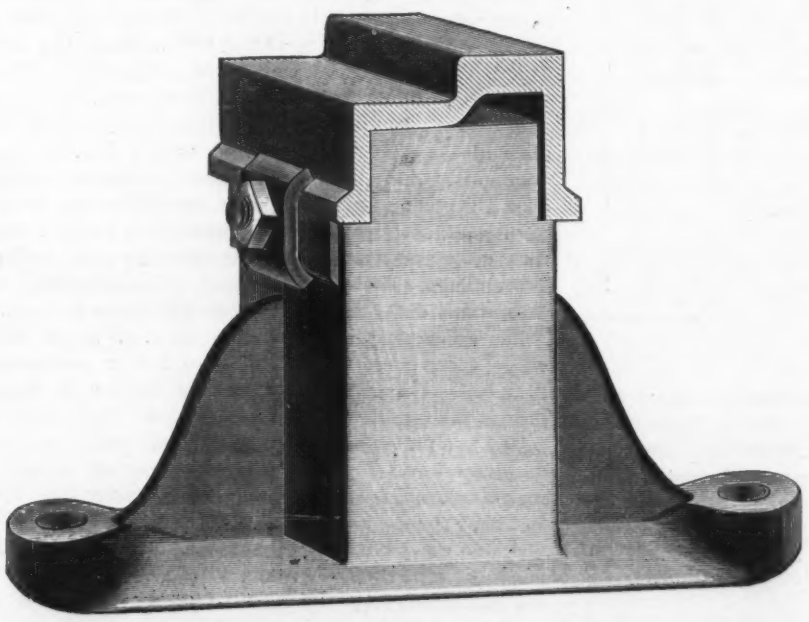


FIG. 1.—WHITE RAIL FOR ELECTRIC SERVICE.

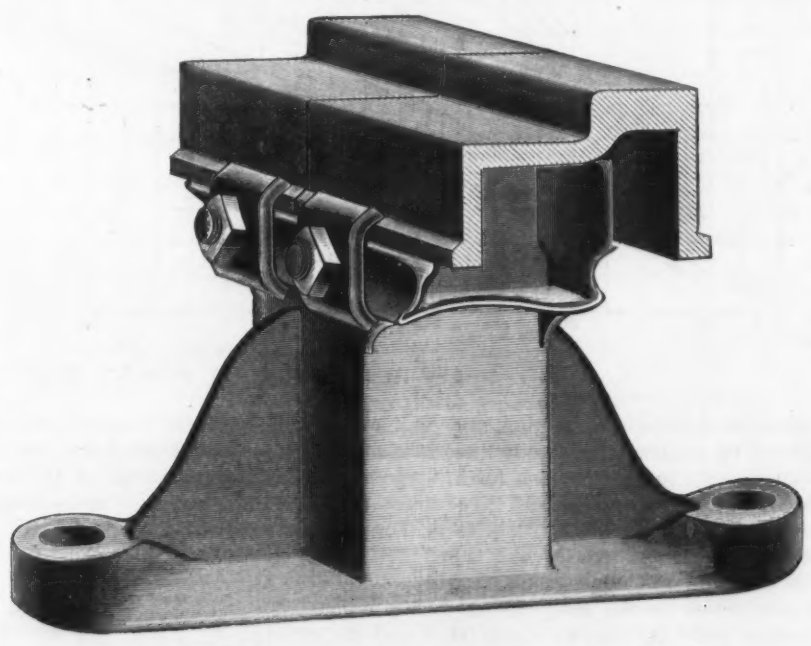


FIG. 2.—WHITE BOX CHAIR FOR JOINTS.

Breaking a Record.

Apropos of some interesting facts that have recently been published concerning the life of incandescent lamps, we are in receipt of a most interesting communication from Mr. McCormick, of the Edison station at Westchester, Pa. He reports a lamp in their plant which breaks, easily, all records hitherto noted. It was an Edison 16-c. p. lamp of 106 volts, and it burned every night from sunset to sunrise, from Feb. 19, 1886, to March 20, 1890, 1,125 days. Reckoning on a basis of average burning period of ten hours per day, this gives to the lamp in question a life of no less than 11,250 hours, breaking even the English record of 10,600 hours at lower voltage.

Mr. McCormick also says that he has now, connected with his street system, Edison lamps of 16-c. p. that have been burning nightly ever since the spring of 1887. Taking it all in all, it really looks as if the incandescent lamp is undergoing a great improvement in the methods of manufacture, which will eventually give trustworthy lamps of life so long that the replacement expenses will be slight.

The McDougall-Martin Motor.

To the Editor of The Electrical World:

SIR: A literal acceptance of the statements made in an article in your issue of April 12, illustrating and describing a new constant potential motor, would have a tendency to overlook the credit due in a quarter that can honestly make several claims in that direction. Having a fatherly interest in the motor described and illustrated, I desire to review the matter.

In partnership with Mr. McDougall I designed the motor in most of its essential details—armature torque, resistance velocity of rotation, current capacity, core proportions, dimension of magnetic circuit, etc. The drawings and mechanical work were done under my supervision.

The method claimed for lessening magnetic leakage was due to Mr. McDougall; but the novel construction of the Gramme ring was designed by me Aug. 17, 1889. I believe it to be susceptible of being covered by letters patent.

The carbon brush holder was designed by me Aug. 3, 1889, and, as I afterward ascertained, by Mr. Chas. J. Van de Poele some two years before. The use of Pacinotti projections was proposed and strongly urged by me for a line of motors embodying even better proportions of design that I was getting out for our use a short time ago.

I am not at all unwilling to state that it is a good motor, and has more backbone to it than any of similar dimensions that I have handled; but, with all due humility, I consider that I am entitled to much of the credit connected with it.

J. MARTIN.

An Experimental Study of Atmospheric Resistance.*

BY O. T. CROSBY.

While making plans for electric train service at very high speeds, it recently became important that I should examine what was known of atmospheric resistance to bodies in motion. Experiments were undertaken with the view of obtaining guidance for the special problem. As in some directions these experiments were of greater range than any similar ones, and as they furnish new values for certain important functions, it seems that they should be publicly reported. The questions presented are:

(A) What are the laws connecting the pressure with variations in relative velocity of air and resisting solid?

(B) What are the laws connecting pressure with variations in (1) density, (2) temperature, (3) humidity of the atmosphere?

(C) What are the laws connecting pressure with variations in (1) size, (2) shape, and (3) angle of incidence of the resisting solid?

(D) What are the constants which, supposing knowledge of the laws of variation, permit solution of a particular case?

(E) What is the relation between pressure of the atmosphere against a rigid body in motion, and that of atmosphere in motion against a rigid body fixed in space?

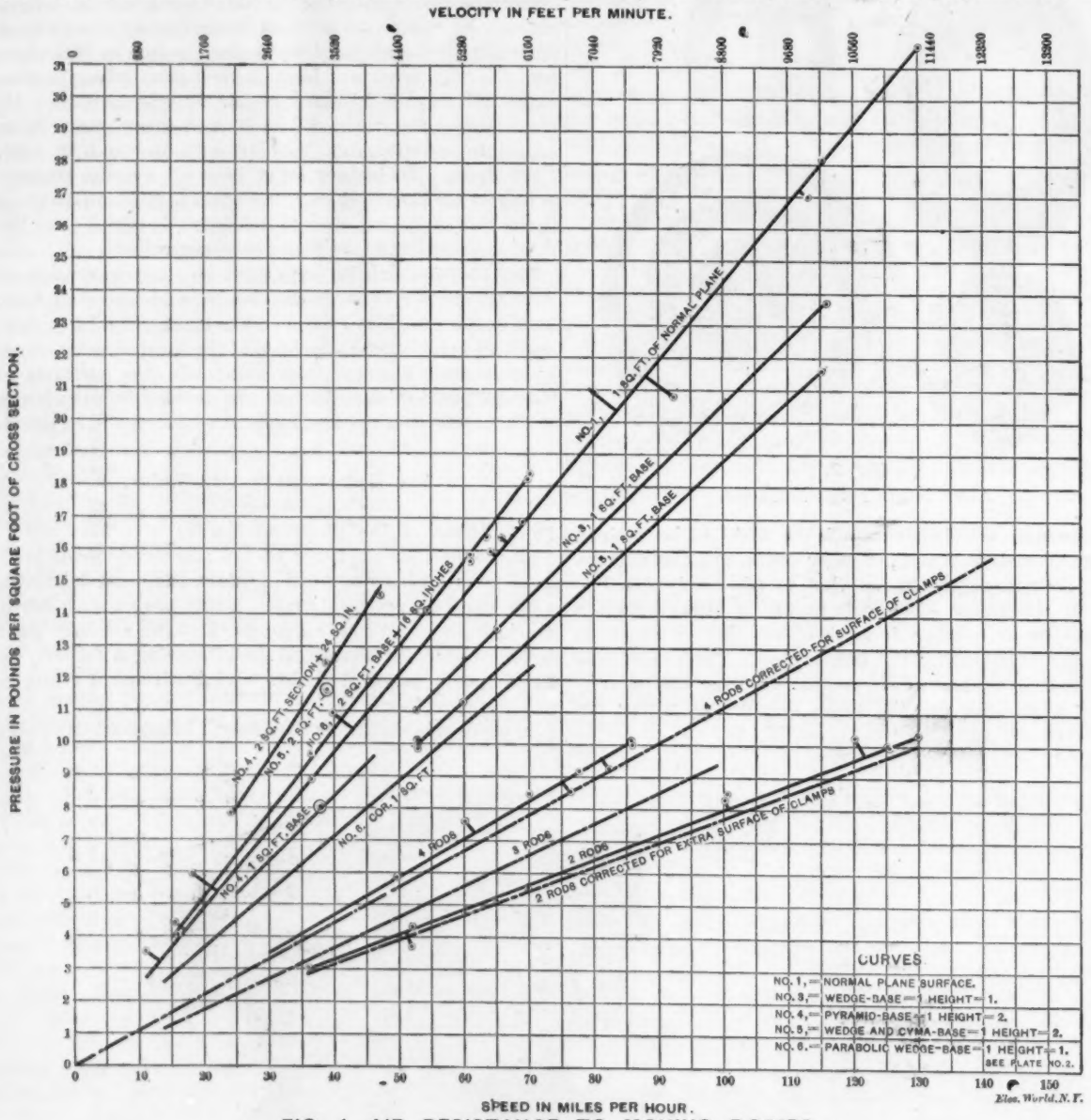

VELOCITY IN FEET PER MINUTE.
0
880
1760
2640
3520
4400
5280
6160
7040
7920
8800
9680
10560
11440
12320
13200
PRESSURE IN POUNDS PER SQUARE FOOT OF CROSS SECTION.
SPEED IN MILES PER HOUR.
NO. 1. 1 SQ. FT. OF NORMAL PLANE
NO. 3. 1 SQ. FT. BASE
NO. 5. 1 SQ. FT. BASE
NO. 4. 2 SQ. FT. SECTION + 24 SQ. IN.
NO. 6. 2 SQ. FT.
NO. 8. 2 SQ. FT. BASE + 18 SQ. INCHES
NO. 4. 1 SQ. FT. BASE
NO. 6. COR. 1 SQ. FT.
4 RODS CORRECTED FOR SURFACE OF CLAMPS
4 RODS
3 RODS
2 RODS
2 RODS CORRECTED FOR EXTRA SURFACE OF CLAMPS
CURVES
NO. 1, = NORMAL PLANE SURFACE.
NO. 3, = WEDGE-BASE = 1 HEIGHT = 1.
NO. 4, = PYRAMID-BASE = 1 HEIGHT = 2.
NO. 5, = WEDGE AND CYMA-BASE = 1 HEIGHT = 2.
NO. 6, = PARABOLIC WEDGE-BASE = 1 HEIGHT = 1.
SEE PLATE NO. 2.
Elec. World, N. Y.

FIG. 1.—AIR RESISTANCE TO MOVING BODIES.

(B) What are the laws connecting pressure with variations in (1) density, (2) temperature, (3) humidity of the atmosphere?

The experiments to be here set forth, made by Mr. B. J. Dashiell, Jr., M. E., and myself, give direct information concerning questions (A), (B), (C) and (D); concerning (E), inference of less certain value is had.

Before detailing the experiments, I will collate some of the authorities on the subject, that their embarrassingly variant positions may be appreciated, and the relative value of the new matter better understood.

Bashforth, a high English authority in ordnance work, concluded that between the velocities 100 and 500 ft. per second, P varies as V^2; between 900 and 1,100 f. per second, P varies as V^6; between 1,100 and 1,350 f. p. s., P varies as V^3; beyond that velocity, P varies as V^2. It is, of course, understood that changes of function are not as abrupt as given for convenience in this scale.

Maycoski, an equally high Continental authority, introduces, in his formula, the square as the function throughout practical velocities.

The great majority of those who have worked in this matter and at the lower velocities have assumed without question that the square of velocity is the only form of the function to be considered. Their experiments have not covered wide ranges of velocities, and in some cases—notably in that of Hagen, generally referred to as one of the best authorities—the actual recorded experiments were far from sufficient to establish the velocity variation.

Whether the true law of velocity variation may not be connected with area variation is a not unreasonable inquiry, but one to which at present no answer can be given.

It is, perhaps, needless to say that a rough exterior offers more resistance than a relatively smooth one. Assuming the body to be of ordinarily smooth exterior and free from longitudinal irregularities of shape, we then have little evidence as to variation of resistance depending upon a variation in shape of perimeter alone, as from a circle to a triangle.

As to angle of incidence, a good deal of experiment has been made, the matter being of prime importance in both civil and military engineering.

Prof. Unwin, adopting the formula, $R = P\frac{2\cos^2\psi}{1+\cos^2\psi}$ (in which R = pressure in direction of motion, and P is equal to pressure on the surface when normal to line of motion) finds for the total (normal) pressure on the surface:

$$N = \frac{2P}{\sec\psi + \cos\psi}.$$

Hemispherical and cylindrical fronts are usually said to offer one-half the resistance against their respective bases.

Borda is quoted as saying "Balls (spherical probably) give only 0.36 to 0.41, and elongated projectiles less than half these values." As to the ratio between spherical and ogeeval headed shot, the ordnance officers, United States Army, determined the constants .000514 and .000385 for the two cases respectively, these constants entering into Didion's formula for projectile resistances. Bashforth gives the following ratios:

Hemispherical	1
Hemispheroidal	0.78
Ogeeval head (one diameter)	0.83
" " (two diameters)	0.78
Flat head	1.53

He further states that the resistance is greatly affected by the slope of the surface joining head and body; this slope should be as gentle as possible.

It may be noted, though not strictly under this head, that a few efforts have been made to determine the effect of change in the shape of the rear end of a moving body, but they have usually been complicated by connection with change in length of the body, and nothing clear on the subject is known. Hutton states that he could determine no appreciable difference of pressure for variations in shape of rear.

(D) Reaching the question of actual determination of values, it is to be remembered that a majority of the experimental determinations of resistance under given conditions are reported in the shape of formulæ involving V, D and A, with a constant coefficient.

Inquiring into the methods used for these determinations, it is found that they have been:

(1) For very high velocities, as in ordnance practice, by measurement of initial velocity and actual trajectory, hence, calculation of available energy and resistances overcome.

(2) By observed fall of bodies of known weight and resisting area.

(3) By drawing bodies in a rectilinear path through air or water.

(4) By swinging of pendulum.

(5) By exposing bodies to impact of wind or artificial blast, or flow of water currents, measuring pressure by spring movement or otherwise.

(6) By whirling bodies through air around a centre.

Results from (1), in so far as applied to the particular projectiles and velocities chiefly used to determine the formula entered, are reasonably accurate. When reduction to low velocities and to a normal plane front is attempted, divergencies are to be noted. No account is taken of supposed length of projectile in making this reduction.

(2) No considerable series of experiments by falling bodies is on record—Newton used this method.

(3) Experiments giving rectilinear motion have been limited to very low velocities and made chiefly in water.

(4) A number of very delicate experiments, at low velocities, have been made by swinging the pendulum. Professor Abbe says: "These phenomena would afford a very accurate means of determining the resistance of the air were it not for analytical difficulties in determining the effect of the varying action of the pendulum during each oscillation."

(5) A great number of impact experiments have been made, both in air and water. So far as the determination of pressure-velocity relation is concerned, they all suppose a knowledge of that relation, or suppose that in some way the velocity of impact can accurately be given. Some accuracy on this point may be obtained by the method of artificial blasts, but none worthy of consideration in exposing to the wind. Much dissatisfaction is expressed by many authorities with the best forms of anemometers—even considering their function to be only that of indicating relative velocities and not absolute measurement in miles per hour, feet per second, etc.

(For fuller information on the subject of anemometers in general see Professor Abbe's Report to Chief of Signal Service, 1887, and article "Anemometers" in Enc. Britt.)

(6) In whirling machines the velocity of the moving body may, of course, be determined with accuracy. True relative velocity is subject to slight error of determination due to disturbances in originally still air, caused by motion of the solid. Measurement of pressure against the solid is usually complicated to a considerable degree by the necessity of eliminating work of friction. This method, however, with modification of detail, has been adopted by many experimenters, especially those working in air.

I had intended to turn a wheel at a very high velocity by an electric motor, wherein the output of mechanical energy can be quite accurately measured. The apparatus actually used and described below was in the main proposed by Mr. Dashiell, my assistant in the general work leading to this experiment.

Description.—The room in which the whirling experiments were made was 40 feet long, 19 feet wide over one-half its length, sloping to 13 feet width across the engine. The height to rafters was 12 feet, with hip roof having 7 feet rise. There were six windows, opening about 9 square feet each, to free air on three sides of the room; also, one door opening about 20 square feet. A similar door opened into another room, itself communicating with open air, and a third double door, about 40 square feet, communicated with a third room opening into free air. Most of these doors and windows were continually open during the experiments. The closing of some of them seemed to make little if any difference in the interior movement of air.

The apparatus consisted of a 90-h. p. steam engine, whose speed could be regulated to half a revolution or even less. Its normal work was the driving at 300 revolutions per minute of a 70-h.p. dynamo. This engine was belted to a pulley set on a vertical steel shaft, 2_{15} inches diameter, 6 feet 6 inches long, running in socket bearings above and below. On this shaft were four collars, two near the top and two near the bottom. Of these two sets, one was keyed, the other loose. The two keyed collars were attached to a system of iron rods forming a triangle, the rods from the upper collar meeting those from the lower collar in the horizontal plane passing through the latter.

At their intersection they carried a two-pronged casting, against which rested the spring transmitting the atmospheric pressure; here was fixed also a wooden plate, to which was attached the card on which the spring movement was recorded. The loose collars were likewise attached to a system of iron rods, two of which (those in the horizontal plane of the lower collar) passed through the middle of the miniature cars, those from the upper collar being bolted to the top of the car, thus preventing any sag due to weight. The length of the radius thus constituted was 5 feet 6 inches.

To the rear of the car was bolted a plate having a central socket. A rod extended from this socket through the forked casting above referred to; back of this casting the rod carried washers and a nut. Over the rod a piece of pipe fitted loosely, and over this, also loosely, the spring, about 8 inches long. The surface of the pipe was well oiled. Springs of three different values were used:

No. 1	Compression of 1-16 inch	= .84 pounds.
No. 2	Compression of 1-16 inch	= 1.55 pounds.
No. 3	Compression of 1-16 inch	= 3.20 pounds.

*Abstract of paper read before West Point branch of the Military Service Institute, April 17, 1890; furnished by the author for simultaneous publication in the London *Engineering* and THE ELECTRICAL WORLD.

To the rear of the car was attached an arm carrying a pencil having spring contact with the card above mentioned. When the shaft moved, under the belt effort, the fixed collars and attached rods pushed the car and carrying rods forward; the resistance of the air was then measured against the elasticity of the spring, the friction of the pencil on the card and the friction of the collars on the shaft. These frictional resistances were scarcely appreciable. A slight effort of the finger would continue a steady motion. Its absolute maximum value is now known to be not more than .02 pound applied at the circumference of the circle of revolution.

When the larger bodies (two square feet cross section) were in position, the lower surface was 2.5 inches above the platform; with the smaller bodies (one square foot) this distance was 5.0 inches.

The linear velocity of the car was known by count of revolutions per second multiplied by length of circumference (36 feet). In most cases the count was direct, in some marked pulsation of the disturbance, and the direction taken by them did not vary more than 15 degrees from the radii drawn through their bases. This almost radial flow is due to the fact that the body is indeed pushing the particles apart, outward and inward, as well as forward, and this lateral flow by the time the rotating body has traveled a semi-circumference past a tell-tale (or other point) has so disturbed any tangential current as to make the general rotary velocity very small. Light objects, placed near the moving body, were blown outward or inward, almost exactly along a radius. This matter has been quite carefully experimented upon by Robinson and Recknagel, and especially by Dohrandt, who determined, in anemometer experiments, this "mit-wind" velocity as 5 per cent. of the velocity of the whirling machine.

This value was also adopted by Recknagel. Robinson obtained values as high as 10 per cent., but himself considered them as exaggerated by reason of the inertia of his mechanism, which recorded a velocity much higher than nearly so, and that (3) and (4) are comparatively unimportant appears from the remarkable agreement of the readings between 50 and 60 miles per hour with other readings obtained under different conditions. Two of these are shown on Fig. 2..

They result from running a car, having a cross-section of 5.1 square feet, at velocities of about 50 miles per hour, and recording atmospheric pressure against this car head. The runs were made on a track about two miles in circumference, hence all question as to mit-wind ceases. The movement was practically rectilinear. The front of the car was made of a wooden plate, mounted on angle-rollers and free to move against a spring, the spring pressing against a rigid cross-bar in the car. The head-plate carried a pencil pressing against a chronograph placed inside the car. The car was propelled by electric motors, its velocity being obtained from the record of a number of observers stationed at intervals along the circular track. Two runs were made with the chronographic apparatus, and read-

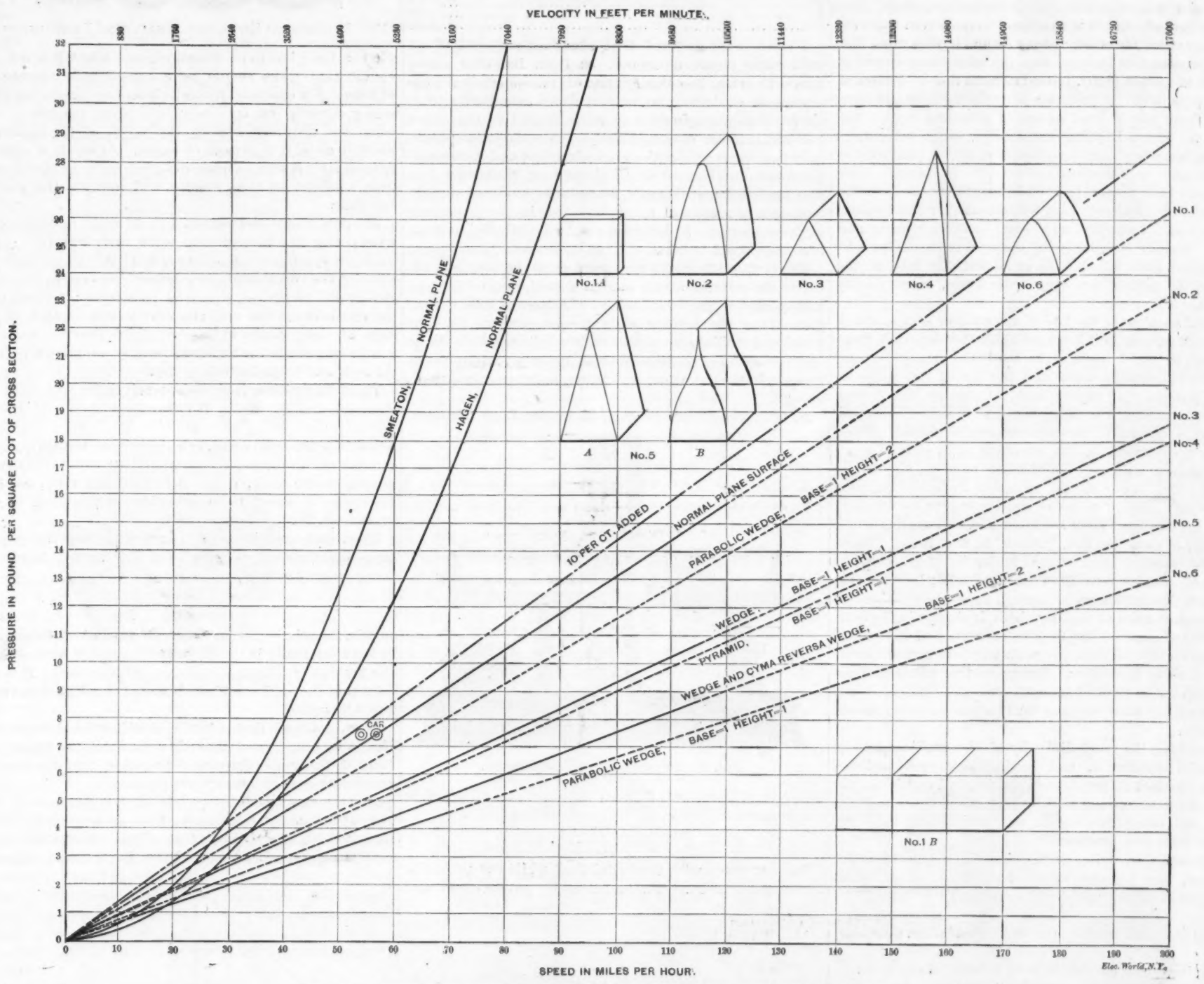


FIG. 2.—EFFECT OF SHAPE OF MOVING BODY ON AIR RESISTANCE.

only the engine revolutions were taken, the car revolutions deduced from the known relation of revolutions.

As will be seen by reference to the plotted observations Fig. 1), the resistance to the rods was separately determined, and for three cases: Four rods, three rods and two rods. This because in testing very short bodies it was not possible to attach four rods. Although the formula for long rods, given above as by Theisen, sets forth a law of variation very different from that to be shown in this paper, yet at 100 miles per hour the resistance for four rods, as per experiment, and as per formula of Theisen, are almost identical. Below that Theisen's values are lower than would appear here. The resistance per unit in the case of four rods is considerably less than in the case of two rods, probably owing to the protection, in the former case, of the rear by the front rods.

The rod resistance for each case, when subtracted from the total, gives the lines plotted in Fig. 2.

The general body of air, in such a room as used, is given a rotary movement by the rotation of the rigid system. The true relative velocity of the air and the body can be known only when this general rotary velocity is known. No accurate measurement was made for this purpose, and indeed, it is almost impossible to make such measurement, as it should be made in the very path of the experimental body. Tell-tales, consisting of vertical sticks carying light strips of paper, were stuck just within and just without the path of rotation. These strips in all cases showed that existing at the instant the body passes a given point, which velocity of "mit-wind" is the minimum of a pulsating value whose maximum is always just behind the body, and not in front of it.

I have, however, drawn a curve (Fig. 2), showing 10 per cent. increase of recorded pressures. This increase, I believe, will cover both the corrections (mit-wind and friction); at low velocities, there is no appreciable remaining rotary movement when the body returns to a given point. At extremely low velocities, since the resistance of friction remains constant, this 10 per cent. does not cover all error, hence for velocities less than 300 feet per minute, no accuracy is claimed. As is usual, inertia of parts was found to present difficulties—indeed it is this that made it impossible to obtain results at very low velocities.

The errors affecting the results here given are:

(1) Possible errors in count of revolution.

(2) Failure to preserve perfect constancy of velocity during a run, thus producing inertia effects in the line assumed to measure pressure only.

(3) Error in measure of mit-wind, with probability that error does not exceed three per cent.

(4) Error in determination of friction of collars and spring—very small except for very low velocities.

(5) Errors of measurement and calculation, under which may be placed possible error in calibrating the springs.

Of these (1), (2) and (5) would probably be compensatory in a considerable number of observations. That they are

ings for maximum velocity are given on plate 2. A third run, not plotted, gave a record on a stationary card. The maximum travel of the pencil in that case gave a result, for 50 miles per hour, within 10 per cent. of those here given, but the exact record has unfortunately been lost.

In these cases the total pressure recorded rises to nearly 40 pounds. The only frictional resistances were due to rolling of the plate, movement of the spring over a lubricated pipe, and movement of pencil over the chronograph The sum of these was well within 0.5 pound, or about 1 per cent. of the total registered.

The plotted values result, of course, from dividing total pressure by the number of square feet in the head and assuming equal pressure per unit for the areas 1 and 5. As seen above, this is known to be very nearly true. The determination of velocity is subject to a possible error of 5 per cent. I cannot but consider this close agreement of results from different methods as an indication of great trustworthiness throughout the range of experiment.

It will be noted that the experimental velocities ranged from 10 to 130 miles per hour, the observations above 30 miles being numerous, thus affording data sufficient to show clearly the velocity relation throughout this latter range from about 30 to 130 miles per hour.

On examining the plotted records of these experiments for information concerning the various branches of the general inquiry, as above divided, we were at once struck by the rectilinear relation between velocity and pressure.

This was altogether surprising to Mr. Dashiell and myself, and, by reason of its variation from general authority, was in a certain sense unwelcome. The close accord of all the observations leaves, on this point, no room for doubt unless there be found some systematic error varying regularly in such a way as to absorb all the pressure due to $V^{\alpha-1}$, "α" being the true exponent. No such error has been discovered. Departing as this relation does from that usually assumed, I cannot find any series of observations more exact and more extended than these, and in themselves establishing over the range here covered, the relation P varies as V.

While I do not consider it a necessary task to frame a theory explanatory of the rectilinear function disclosed by the records here presented, and while I am not sure that one can now be framed, yet the following consideration seems to be of some value. It was set forth by Dubuat in his great treatise (and perhaps by others before him) that a sort of fluid prow is built up in front of an object having motion relative to the surrounding fluid. This was particularly stated with respect to motion in water, as some sort of visible evidence may be had in that case. Let us suppose, as does Dubuat, that the same thing occurs in the case of motion in air. Indeed it seems that by reason of its compressibility, a resisting or resisted gas would more readily form into a head volume of abnormal density, the shape of whose limiting surface (or more accurately, merging boundary) may be a function of the perimeter of the solid and of the velocity of relative movement. This shape may then become more and more favorable (*i. e.*, the true angle of incidence may become smaller and smaller) with increase of velocity, up to some limiting velocity and shape. Within this range of changes in the fluid prow, the change may be such as to defeat the law of the squares, to which we are, deductively, most readily brought.

Beyond such range the law of the squares may establish itself; still further, this law may again be departed from by reason of rapid increase in the "non-pressure" at the rear (this is Dubuat's term) and the law of the cubes or higher powers may appear; and yet further, this "non-pressure" reaching a limiting value, or possibly becoming constant, a return to the square may be found. Thus, possibly the changes in the exponent of V, insisted upon by the highest authority in ordnance practice, may be explained. That there should be some change in the pressure-velocity relation in case of great change in the velocity, we are led to expect from the latest and best studies of the dynamics of gases (see Art. "Atom" in Enc. Britt). There is beyond question local change in density of gases due to change of relative velocity of gas and solid; how far this may go we do not know.

But with change of density there is change in the relative value of pressure due to kinetic energy of individual particles and that due to interaction of component particles each upon the other. Owing to this change, those laws supposed to be most general—such as Boyle's law—are found to apply with varying accuracy under wide ranges of density.

Recognizing the great difficulty of the problem from a theoretical standpoint, and having become acquainted with the conflict of previous experiments, I feel it not unreasonable to accept the rectilinear relation over the given range, until other experiments may conclusively show the error of those now presented.

We should then write, for velocities from 30 to 130 miles per hour, and for one square foot cross-section, with prolongation of body to the rear (see Fig. 1),

$$P=0.131\ V \qquad \text{or,}$$

if the 10 per cent. increase for "mit-wind" effect be added,

$$P=0.1441\ V,$$

P being in pounds per square foot, V in miles per hour.

In applying this to larger surfaces than five square feet (the area of the car run at 50 miles per hour), it may be necessary to apply some correction. No value for this correction can now be given, as the whirling experiments, with one and two square feet, and the car experiment, with five square feet, disclose no clear difference in pressure per unit of surface.

To show that the formulæ hitherto accepted are much at fault, either in the determination of constants, or in the form of the function, let us apply various values of atmospheric resistance to some practical cases.

From dynamometer records taken on a N. Y. Central passenger train, Mr. P. H. Dudley found 766 h. p. developed at 51.4 miles per hour. The train consisted of engine, tender, three day and six sleeping coaches.

Surface exposed (reduced in the matter of shape):

Engine.	Sq. Ft.
Boilers	16
Cylinders	8
Cow-catcher	12
Cab	20
Fire-box	10
Head-light and smoke-stack	6
Drivers	8
Swivelling truck and wheels	8
Sand-box, dome, whistle, bell, pipes, rods	10
	98
Or very nearly	100
Tender	30
First car-front	50
Eight additional car-bodies (separated by about six feet), and covering window irregularities, etc	120
80 wheels, 40 axles	40
Trucks, brakes, steps, etc	50
Total for train	390

Atmospheric resistance:	Pounds.
(*a*) Following Smeaton's rule	5,304
(*b*) " Hutton's "	5,538
(*c*) " Hagen's "	4,290
Total recorded pressure	5,585
Leaving for all other resistance:	
(*a*) Smeaton	281
(*b*) Hutton	47
(*c*) Hagen	1,295

From a careful test by indicator cards, made on the same railway, October, 1889, Mr. Sinclair obtained for a velocity of 52 miles per hour, and for a train of seven vestibuled cars, total horse power developed (mean of several results) 664, or in pounds, 4,788.

In this case we have a reduction in surface exposed—

For vestibule—say 7 feet on 7 cars	50
Two car-bodies, 16 wheels, etc	45
	95
Leaving nearly	300
Then, again, for this surface:	
(*a*) Smeaton	4,080
(*b*) Hutton	4,260
(*c*) Hagen	3,240
Subtracting from 4,788, we have	
(*a*)	708
(*b*)	528
(*c*)	1,548

When it is remembered that about six per cent. of the total horse power developed, as from indicator cards, should be taken to cover friction of machinery in the engine, it is evident from the very small remainders given above, that atmospheric resistance by any of the above formulæ is much overestimated, as in some cases practically nothing is left for the work of friction and oscillation, the maximum (Hagen) being about four pounds per ton. The application of Hagen's formula is rendered slightly uncertain by reason of many variations in the magnitude of the perimeter. It has been assumed that the average perimeter could be taken as eight linear feet.

The remainders in the two cases given, become, according to the determinations here presented, about 2,900 and 2,500 pounds respectively, values, which are at least reasonable. They show about eight pounds per ton for frictional and oscillatory resistances; it will be agreed by those familiar with the subject that this figure is certainly low enough, hence the value for atmospheric resistance high enough.

As to branch C, the average of results from Theissen,

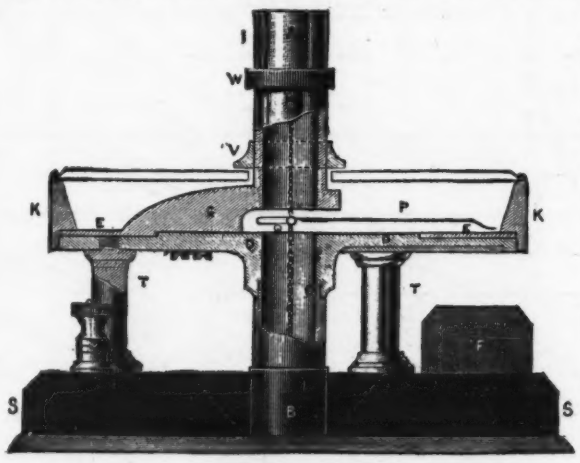


Fig. 1.—Twisted Strip Voltmeter.

Wenham & Browning, Hutton, and those now recorded, is not inaccurately expressed by the simple formula:

$$\frac{\cos.\ \varphi + \cos.^2\ \varphi}{2}.$$

It is presented with the belief that, while not proven to be absolutely accurate, it seems to be an excellent and simple guide.

A practical application of some interest, and which I have not elsewhere seen, arises in determining the total pressure in direction of motion in case a certain base area is to remain constant, the angle of the head being changed. In this case the area exposed increases with sec. $\varphi = \frac{1}{\cos.\ \varphi}$. Multiplying the above expression for pressure per unit area by this expression for increase of area, we have:

$$P = \frac{1 + \cos.\ \varphi}{2}.$$

It will be noted that the pyramid, of equal obliquity with the longer wedge, gave resistances considerably higher. This is probably to be explained by the fact that the four masses of air thrown outward by the four faces interfere along their boundaries, resulting in greater lateral density than in the case of the dihedral angle. Moreover, the lower face, having its lower edge only three inches from the floor, doubtless met a somewhat greater resistance, due to the crowding of the air under the car.

The beneficial effect of curved surfaces is shown in the low value of P given by the parabolic wedge. It reduces the pressure as compared with normal pressure on its base by one half.

Changes in the length of the body and also in shape at rear were tried, but no appreciable differences established.

Concluding, I should say that, although the experimental results here recorded seem trustworthy, and cannot now be distinctly overthrown or set aside, yet, by reason of the great conflict of evidence, this important matter of atmospheric pressure calls for a very extended and careful series of tests. The cost of determining formulæ true beyond any question, would be repaid many times every year in applying them to the true economy of engineering structures.

Ayrton and Perry's Twisted Strip Voltmeter.*

At the Physical Society some years ago, I announced that a strip of material to which a permanent twist had been given behaved in much the same way as one of our now well-known springs; that is, when it was elongated by axial forces there was a relative rotation of the ends; in fact, the twist gets less. As some people have a difficulty in understanding what I mean by a twisted strip, I have prepared Fig. 2 to illustrate my meaning.

The relative rotation is perhaps better seen in a strip whose permanent twist is right-handed at one end and left-handed at the other. If a point be attached to the middle, as shown at $A\ Q\ B$, Fig. 1 or Fig. 3, and the ends are pulled out, the pointer rotates. This double-twisted strip we have applied to weighing machines, aneroid barometors, and many other instruments, such as wire-testing machines; and I can recommend its use in all cases

Fig. 2.—Twisted Strip for Measuring Instruments.

where a force has to be measured, and where it is not advisable that there should be a considerable amount of yielding. For example, spring balances are sometimes used acting directly on specimens as testing machines; but when the specimen breaks, the recoil of the balance is likely to cause it to get out of order. Again, if a double-twisted strip is used as a tension piece in a jointed structure, a pointer set at its middle will indicate the pull at any time.

The only likely suppositions I could make in thinking of what occurs in a twisted strip were, first, that two spiral filaments symmetrically disposed relatively to the axis resembled the two threads in a bifilar suspension, if a sufficiently short length of strip was considered; second, that the tensile stress was uniform over a cross section of the strip at right angles to the axis; third, that the resisting couple was due to the torsional rigidity of the section of the strip still taken as rectangular.

These suppositions lead to the result that

$$\varphi\ \alpha\ \frac{W l n b}{t^3},$$

when W is the axial force, l the length of the strip, n the number of complete spires given by permanent set to unit length of the strip, b the breadth of the strip, and t its thickness, φ being the small rotation produced by the small load, W.

Now, such experiments as I have made hitherto on steel strips point rather to some such law as the following, being roughly correct,

$$\varphi\ \propto \frac{W l}{b\ t^3};$$

that is, the rotation seems to be independent of the amount of twist originally in the strip, and instead of increasing as the breadth of the strip increases, it diminishes. It is evident that the action is a much more complicated one than I had imagined.

Now, I found that when a double-twisted strip was placed in tension and its ends were fixed, the pointer rotated if the temperature was altered, so that its use as a pyrometer or thermometer was possible.

In this instrument before you (Fig. 1) we have a tube $A\ H\ D\ C\ B$, about two-thirds of whose length, $A\ H\ D$, is brass and about one-third, $C\ B$, is iron. A double-twisted strip of platinum-silver is in tension in the axis of the tube

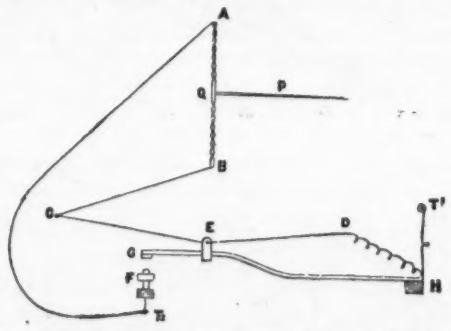


Fig. 3.—Arrangement of Fuse for Voltmeter.

with its ends fastened to the ends of the tube, but one of them electrically insulated from the tube. The tube just at the middle of its length, $D\ G$, becomes a strong thin bracket, which enables a pointer, $Q\ P$, attached to the strip to make a rotation of nearly 360 degrees, and the arrangement of the bezel and dial will readily be understood without any further description. A and B are caps to the ends of the tube. When the cap A is turned the initial pull in the string is altered and thus furnishes a zero adjustment.

When the various parts of this instrument are all at the same temperature the pointer remains in the same position whatever that temperature may be. When a current is passed through the strip the pointer records the difference of temperature between the strip and its case, and hence the readings of the pointer on the dial may be made in ampères. Again, the readings may be in volts for the potential difference between the ends of the strip or the terminals of the instrument. These instruments before you read to 2½ volts. They waste almost exactly *one watt* at their highest reading.

* A Paper read by Prof. Perry at the British Association Meeting at Newcastle, 1889.

By inserting resistances of platinoid, or of German silver, we can increase the range of the instrument, but, of course, we expend more energy in such a case.

That there may be no creeping or sub-permanent set or hysteresis, we find it sufficient before graduation of the instrument to keep sending a current greater than the highest which is to be used on the instrument for 72 hours, breaking and making the current once in every minute. This process is performed by the second hands of a clock passing into and out of a bath of mercury in every revolution. It is quite wonderful to observe the complete change in elasticity produced in a strip by this kind of fatigue. The strip seems to undergo no alteration afterward by mere use or disuse; but it is my intention to test this by many months' experience before allowing these instruments to be manufactured. The two instruments before you are the only two yet made.

Fig. 3 shows our fuse arrangement—T^1 and T^2 are the terminals of the instrument. Current flows from T^1 through the short thin copper wire T^1H, then through the adjustable resistance coil HD; then through the tightened platinum-silver wire DEC, whose ends are fixed, and which is kept sagged and tight by the metal spring HG; then through the twisted strip BA to the terminal T^2. But should the voltage between T^1 and T^2 be so great as to be liable to hurt the instrument, the wire DEC sags so much that the end G of the spring short-circuits the instrument through GH and the thin copper wire HT^1, the copper wire being instantly melted.

I had hoped to be able to show you another instrument in which the strip is of flashed carbon. Here are specimens of twisted carbon strips, but unfortunately they are all too coarse for a 50-volt instrument, which is what I intended them for.

For accumulator work the 2½-volt instrument is greatly needed, and I prefer this form to our hot-wire instrument because of its great simplicity and its needing so very little adjustment in manufacture.

For alternating currents this 2½-volt instrument may be used through any range whatever by placing a small transformer on the base of the instrument. The little trans former before you transforms in the proportion of 50 volts to 1, so that the instrument may be used on the ordinary 100 or 110 volt circuits. By using a different winding on the transformer the same instrument may be graduated for a 1,000-volt circuit. I find that this transformer maintains the same proportionate transformation of voltage whether the frequency of alternation of current is 50 or 100 per second.

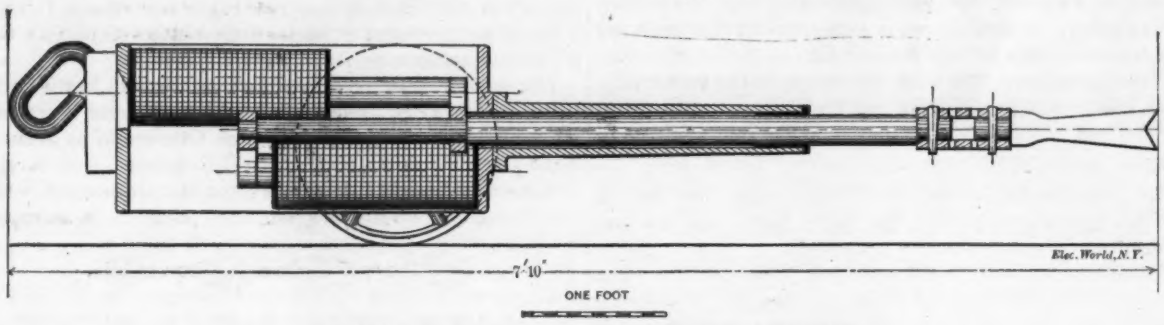
This pleasing result was not altogether unexpected, but it certainly was unexpected to find that if a sufficient quantity of iron is used in the transformer there is a constant ratio of transformation of *current* for quite different frequencies of alternation. Hence, I find that this 2½-volt instrument may be graduated as an ammeter up to 1,000 ampères or more, or a voltmeter to 1,000 volts or more, the transformer being the only variable thing about it. I need hardly say that with several transformers and resistance coils at the side of this instrument, we may almost call it a universal instrument.

NOTE.—The above paper is given as it was written in September last. When it was written the author felt certain of the constancy of the fatigued strips. Six months of further experience have since confirmed his views.

THE FAST TELEGRAPHER'S MEDAL.

A New Coal Mining Machine.

Just now there seems to be a rapid extension of the application of electrical power to mining operations. The machine shown in our cut is of that class wherein there are reciprocating parts only, so far at least as the operating of a drill is concerned. Two pairs of magnet coils furnished with U-shaped cores actuate the drill; one withdraws the projectile, and the other draws it forward against the bit, with a speed that may be varied to meet the requirements of the case. The usual speed is 200 blows per minute, with an 8-inch stroke. There are no springs of any kind in the machine, the current being automatically shunted from one set of coils to the other to deliver the successive strokes.



MORGAN ELECTRIC COAL MINING MACHINE.

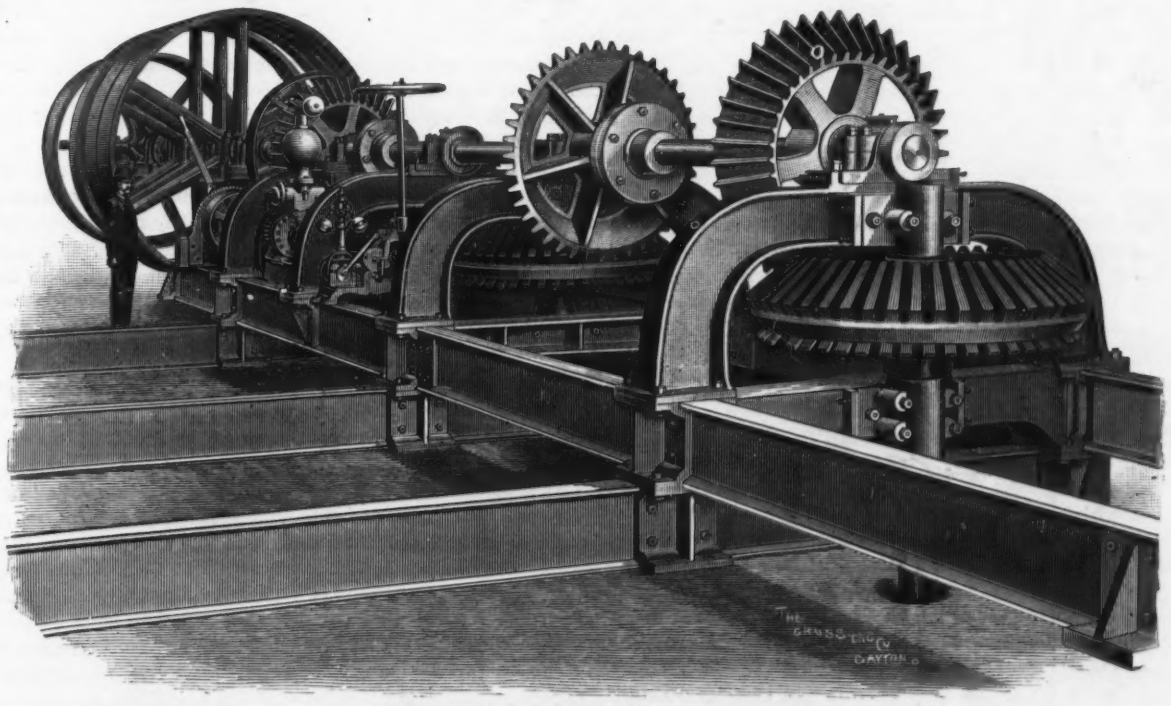
The machine is the invention of Mr. E. C. Morgan, of Chicago, and has already passed the experimental stage, one of them being now in successful operation in a well-known mine, where it is cutting 4½ to 5 feet of coal. It can evidently be used for other kinds of drilling purposes.

Although the machinery is somewhat long, it is remarkably light, the total weight being only 750 lbs. Great weight is often an inconvenience that seriously hinders the use of electric mining machines, and any advance in the direction of a light and easily manipulated drill will be of service to the various classes of mining interests.

Gearing for Turbine Water-Wheels.

In our last issue we described the hydraulic power station at Harrisburg, Pa. It will be remembered that in that case the power was supplied by four Victor turbines, operated directly upon the same horizontal shaft, without intervention of gearing.

The present cut shows a modification of hydraulic power transmitting apparatus, in which the turbines act through the medium of gearing upon the driven horizontal shaft and its pulleys. This arrangement is necessary in certain stations, and Stilwell & Bierce, who furnished the turbines for the Harrisburg plant, employ the above form in many of the power plants installed by them for various uses. In very many cases a horizontal shaft attaching directly to the turbines is desirable, and this alternative form is of some interest as showing the flexibility of the turbine in furnishing power under almost any circumstances of water supply.



GEARING FOR VERTICAL TURBINES.

The Fast Telegrapher's Medal.

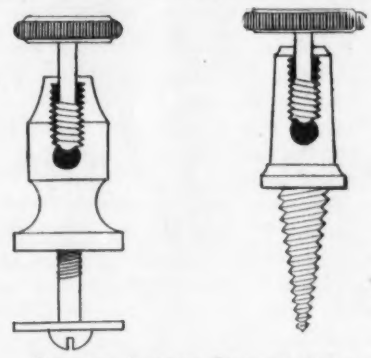
Apropos of the recent fast telegraphing tournament, we show in the cut on this page the medal presented to the victor. The gift of this medal was due to the enterprise of our daily contemporary, the New York *World*, and shows a fitting appreciation of the splendid records that were made during the tournament.

In passing, it is worthy of notice that the results of that test are attracting no little attention abroad, and have created some surprise among our English cousins, who apparently supposed that the maximum speed of sending was attainable only by the modified Morse system in use on the other side of the Atlantic.

A Peace-making Binding Post.

Nearly every one that has had anything to do with electrical instruments knows what it is to lose binding post screws—generally at the most inopportune and inconvenient moment. When one is standing over an instrument with a wire in each hand, and a screw sees fit to tumble out and drop into a crack in the floor, the effect on the average man is to produce anything but amiability. In shipping instruments, too, it not unfrequently happens that an instrument turns up at its destination minus this small but very necessary part.

The improved binding post shown herewith has just been brought out by The E. S. Greely & Co., of New York, with a view of obviating this slight but exasperating difficulty. The screw of the new binding post cannot come out, but it backs up just far enough to clear the hole. The thread of the screw is on a shoulder larger than the stem, and, as the neck of the key is turned tight up to the stem, the screw part cannot pass.



DELANY SAFETY BINDING POST.

The binding posts look like the ordinary kind—made in all sizes and shapes. For many purposes they must come into extensive use, for the convenience of the device is evident at a glance. One great advantage that is secured is, that when wiring has to be done in dark, out-of-the-way places, one can know precisely when the wire hole is clear, and can work without danger of losing the screw in the very darkest corner. It is certainly a meritorious and convenient modification of the forms in ordinary use.

The Patent Office is not Witty.

To the Editor of The Electrical World:

SIR: This communication is prompted by a paragraph in the WORLD of May 17 headed "The Patent Office's Conception of Wit." To censure is easy, but to achieve beyond criticism most difficult. I make no comment as to the refusal of a transformer patent in 1883 and the grant of such a patent in 1886, beyond the remark that in 1883 it may not have been obvious to every one, even to a Patent Office examiner, that such a system was feasible, and certainly if in 1883 the objection was raised that the thing was impossible, it was the privilege, as well as the duty, of the applicant to demonstrate that the examiner was in error. Where an examiner grants to an applicant a broad claim on a "venerable and time-worn device" with which the applicant has been familiar since early childhood, it is certainly to be regretted, in that it misleads the public; and it is specially unfortunate for the applicant, because it places him in an unenviable position. Certainly, the

claim would never have been granted to him had he not solicited it, and presumably he swore in making his application that he was the original, first and sole inventor of the "venerable" device; and in any event he, either by reason of his own misplaced enthusiasm, or the ill-judged act of his attorney, was responsible for the presence of the claim in his patent. It was, no doubt, an error on the part of the examiner to allow the claim on the antique device, which both the applicant and his attorney deliberately asked for, but it may have been a mere inadvertence. It is a matter of surprise, considering the magnitude of the business of the Patent Office, that such errors do not often occur, especially when one reflects that it is a common practice for inventors and attorneys, who, perhaps, may be very indifferently informed or totally ignorant as to the state of an art, to claim everything, and throw upon the Patent Office examiners the duty of eliminating from the case what is old and spurious. EDWARD C. DAVIDSON.

New York, May 14, 1890.

Generation, Distribution, and Measurement of Electricity in Canada.*

BY A. J. LAWSON, C. E.

Being one of the pioneers in construction of electric lighting plants in Canada, and the manufacturer or constructor of nearly 30 per cent. of the total capacity of incandescent lighting installations now in operation in the Dominion, the writer submits the following brief history of the progress of the electrical industry in this country.

Ten years ago there was not one electric light plant in operation in Canada. The first plants erected were Brush arc plants of small capacity. About the end of December, 1882, some Thomson-Houston arc lights were placed on exhibition in this city by the Thomson-Houston Electric Light Company, of Canada, afterward the Royal Electric Company, of Montreal, lighting St. James street, Beaver Hall Hill and part of Dorchester street; but the first permanent installation for street lighting in Montreal was that supplied from a Brush dynamo owned by the harbor commissioners, who by this means lighted the harbor, wharves and approaches.

In the fall of 1883 some 50 arc lights of the Hochhausen and Vandepoele systems were placed in the streets of Toronto, and Winnipeg also had some arc lights put into operation about the same time. In May, 1885, Ottawa adopted the Thomson-Houston arc light for its streets, replacing thereby both gas and oil, and in 1887 Quebec followed its example, and Halifax and other places followed.

In 1889 Montreal gave a contract for the electric lighting of the whole of its streets to the Royal Electric Company for a period of five years, a portion of the city having been lighted by the same company since 1886. Hamilton is now also lighted by the arc light, and St. John, N. B., has recently contracted for the lighting of the whole city, dividing the lighting between the companies operating the Thomson-Houston and the Brush systems, so that now the following cities may be said to have adopted exclusively the arc light in place of gas or oil: Montreal, Ottawa, Quebec, Hamilton, London, Winnipeg, Victoria, Vancouver, Halifax, St. John, N. B., St. John's, N. F., Moncton and Sherbrooke, besides the majority of the towns throughout the Dominion, so that now comparatively little work remains to be done in arc lighting, incandescent lighting for residences and stores being the principal field remaining unoccupied.

In 1882 two private installations of incandescent lights were made in the city of Montreal. The system employed was the Maxim, which was put into the St. Lawrence Hall and Bank of Montreal. So crude was the construction of these plants that they proved unsatisfactory, and after a very short time both were discontinued. In the St. Lawrence Hall only one lead was carried from the dynamos to the lamps, the return being made through gas and water pipes, a method which, it need hardly be pointed out, would not now be permitted by the Board of Fire Underwriters. The wire used in the Bank of Montreal for mains did not even have the coating of paint which would have gained for it the misnomer of "Underwriters' wire," but was merely single cotton-wound magnet wire. This is not pointed out as reflecting in any way on the Maxim Company: all companies' systems at that time were about equally crude.

In the fall of 1882 a contract was made for lighting the Canada Cotton Company's mill at Cornwall with the Edison light. A plant of 500 16 c. p. lamps capacity, constructed under the superintendence of Mr. Byllesby, now vice-president of the Westinghouse Company, was started on Feb. 28, 1883. In June, 1883, an exhibition Edison incandescent plant was placed in the *Mail* building, Toronto, but was discontinued a few months later.

The Montreal Cotton Company's mills at Valleyfield were next lighted in September of the same year, 800 lights being placed, which number was subsequently increased to about 1,100 lights. The Canada Cotton Company's plant was also increased at the end of the year to 1,200 lights, and it is now the largest private installation in Canada. In January of 1884 two competitive plants of small capacity were placed in the Parliament Buildings at Ottawa, for the lighting of which the writer furnished, in 1886, Edison machinery of a total capacity of 1,000 lights.

The first incandescent electric light station in Canada was started at Victoria, B. C., in January, 1887, and was followed by that at Vancouver, B. C., completed in September of the same year. The distribution from both stations is on the three-wire system.

The station at Calgary, N. W. T., was completed and started in October, 1887, and in January, 1888, the station at Valleyfield, with overhead conductors—at that time the best constructed of all the Edison stations in Canada—was put into operation. For these four stations the writer supplied and erected all the machinery, and remodeled the stations originally constructed in the two first-named places.

The Cornwall station on the Westinghouse alternating current system, completed the same year, was the first alternating current station in Canada.

Toronto is the only place in which underground wires have yet been placed, but the Edison station, from which they are fed, has only lately been put into operation. It is the intention of the older Toronto Electric Light Company to put under ground the wires for arc lights and for the alternating current plant about to be installed.

The Barrie central station, which the writer has constructed, is the latest completed central station plant, and the only one in the Dominion on the alternating current system carrying 2,000 volts in the primary wires and nearly 100 volts in the secondaries, and it is one in which the highest quality of insulation, both of primary mains and house wiring, has been used.

As to motive power, unfortunately in a great many cases where steam power is used, it was assumed in the early stages of electric station construction that any kind of steam plant would answer. Old slide-valve engines which drove as antiquated machinery as themselves in machine shops, sawmills, woolen factories, and like places during the day were used at night for running electric light machinery, and very good reason naturally existed for the complaints made of the unsteadiness and unsatisfactory character of the lights supplied.

High-speed engines belted direct to the dynamos were next tried, and having been found to give much better results in point of steadiness, a number of builders, who had had no experience in such work, undertook the manufacture of this class of engines, and evidently tried to combine the old designs for agricultural engines, upon which their previous practice was based, with some of the principles embodied in the best class of engines sold in the United States for electric light purposes. The product was a mechanical curiosity, and a failure. It is safe to say that in not one of the Canadian shops building these engines in the early history of electric lighting in Canada was there a proper equipment for the manufacture of high-speed machines of any kind. No parts were made to gauge; so that in the event of a break-down the broken part could be duplicated without sending it back to the shop as a model. A reaction soon afterward set in in favor of slow-speed engines, especially for arc lighting, and at the present time, with few exceptions, engines of the Brown and Wheelock types are used in all arc light stations in Canada operated by steam power. For the running of incandescence plants, however, high-speed engines, mostly of American manufacture, have obtained the preference to which their excellent qualities and performance entitle them.

Brown engines furnish the motive power for the central stations in Montreal, Toronto and Winnipeg, both Brown and Wheelock engines are used in Halifax and London, and Wheelock engines in Hamilton, while Armington & Sims engines are the prime motors in the stations in St. Johns, N. F.; St. John, N. B.; Calgary, Alta.; Vancouver and Victoria, B. C., and in the parliament buildings at Ottawa.

At Quebec, power is obtained at the Falls of Montmorency, nine miles distant, to drive the Thomson-Houston arc dynamos and Thomson-Houston alternating current incandescent machines.

At Peterboro, water power is used to drive Thomson-Houston arc dynamos, from which 137 arc lights and a number of Bernstein incandescent lamps in series are supplied. At Barrie, Ont., a stream five miles distant from the town furnishes the power for both the arc and Brush alternating current incandescent plants.

Also in Ottawa, Cornwall, Smith's Falls, St. Catharines, Welland, Dunville, Thorold, Sault Ste. Marie, Sherbrooke, Joliette, Valleyfield, Almonte, and some other places, for both factory and central station lighting, water furnishes the motive power, the total horse power from turbines used for electric lighting and power transmission in the Dominion being 4,520, or more than one-fifth of the whole power thus utilized in this country.

The dynamos are not coupled direct to engines in any of the Canadian stations. Ordinary double leather belting, made without seams or rivets, is generally used. Belting should not be overtaxed. One inch width of double leather belting running at a speed of 750 feet per minute will easily transmit one horse power, and at this tension will last a long time. Rope driving may eventually be used, as it has many advantages; but so far, with one exception in an isolated plant, the method has hitherto not been tried in Canada.

Storage batteries have not been applied on this continent to any such extent as they have been in Europe. Wherever they are employed except for propulsion of street railway cars, it has been for the purpose of securing light after engines and dynamos have been stopped at night, and for railway car lighting.

Outside of these plants storage batteries have been used in five or six places in Canada, among which may be mentioned McGill College, where the lights run from a Gibson battery in the basement. The battery is charged from a small shunt wound dynamo, driven by an Otto Gas engine made by Crossley Bros., of Manchester.

The same kind of plant and battery are used in the residence of Mr. F. R. Redpath. The plant is in the basement of the house. The gas engine is an Otto made by Messrs. Schleicher, Schuman & Co., of Philadelphia, and is the steadiest running gas engine in Canada. Its weight, with two 54-inch fly wheels, is about 3,200 pounds. It indicates 3.9 h. p., with a gas consumption of 26 cubic feet per h. p. per hour. Over the cylinder is a cast-iron saddle, on which the dynamo, a shunt wound machine made by Holmes & Co., of Newcastle-on-Tyne, imported by the writer, is placed, there being just one-quarter of an inch clearance between the rims of the fly wheels and the ends of the dynamo bed. Behind the dynamo and attached to the bed of the engine are two wrought-iron adjustable arms carrying the countershaft and idler pulley. The dynamo pulley is, therefore, between the idler and the fly wheel of the engine, is double crowned and is lapped over nearly the whole circumference by two belts. The slip is less than two per cent. The speed of the machine is 180 revolutions per minute. The dynamo weighs 430 lbs., and the idler pulley and countershaft 100, so that the total weight of engine, dynamo and driving gear is 3,800 lbs. A box 7′ 4″ × 2′ 8″ × 5′ 2″ would cover engine, dynamo, belting, idler pulley and countershaft, and the whole might be thus shipped to any distance completely set up ready for connection of gas and exhaust pipes. The arrangement of the plant was designed by Mr. Redpath, and is most compact and ingenious.

There are 42 cells of Gibson battery, capacity 150 ampère hours, and they are connected in two sets of 21 each in parallel, the charging current being 33 ampères at from 45 to 55 volts pressure. These cells are arranged on shelves in the engine room. The plates in this battery are placed horizontally instead of vertically as in other batteries, and have thus the advantage of being less liable to short circuiting through paste falling between them as it does in vertically arranged plates. A slight disadvantage is that the internal resistance is higher than some other forms of battery owing to the plates being further apart; but this is compensated for by the longer life of the Gibson, the makers guaranteeing to keep it in order for 10 per cent. per annum of the first cost. The electrolyte used is dilute sulphuric acid with the addition of sulphate of soda, the density of the combined solution being 1.220. This battery will stand heavier charging than any other, and has frequently been charged with a current of 75 ampères; but the most economical practical charging rate is about 30 ampères. In charging the current is measured by a Weston ammeter and the pressure by a Weston voltmeter. There is also another Weston voltmeter in the library upstairs, and underneath it a resistance switch of German silver in series with the battery, by which the pressure in discharging is regulated, as the battery, when first connected to the lamps after charging, is higher in E. M. F. than when nearly discharged, and the lamps used are of course of such voltage that they will give their full light at the lowest pressure to which the battery in practice is reduced. The maintenance of perfectly uniform light is thus under control from Mr. Redpath's arm chair.

This is the first and only complete private installation for residential lighting in Canada, and was first started five years ago, shortly after the visit of the British Association to this country.

At the present time there are 13,530 arc lights and about 70,765 incandescent lamps in use throughout the Dominion. There is hardly a village in Ontario, having a population of over three thousand inhabitants, which has not an electric light station of some kind in operation, and few of the important towns of the other provinces are without electric lighting. Most of these, it is true, are arc lighting stations, but about a dozen supply the incandescent light only, chiefly to stores and public buildings, the lighting of residences being yet scarcely entered upon. Several of the local companies which have hitherto supplied the arc light alone, or with a few incandescent lamps in series with their arcs, or in series-multiple with them, have recently purchased and put into operation incandescent alternating current plants; and the various lighting companies formed for the supply of incandescent lights only, have also found it necessary in most cases to add arc lighting to their business, it having been sufficiently demonstrated that the incandescent light is unsuitable for street lighting, the public demanding for electric lighting, whether arc or incandescent, a much better illumination than is usually obtained from gas lighting, and in this respect the incandescent light has failed to meet the expectations of its advocates. The Edison municipal system has been used for street lighting on the Lachine Canal, and at Vancouver, Valleyfield and Chatham, N. B., but is being replaced by arc lights in the two first-named places.

The principal electric lighting stations in Canada of

*Abstract of paper read May 8, 1890, before the Canadian Society of Civil Engineers.

which the capacity is 100 arc lamps of 2,000 nominal candle power or over, or 1,000 incandescent lamps of 16 c. p. or more, are :

PLACE.	No. of Arc Lights.	Inc. Lights, 16 c. p.	System.
Barrie, Ont	75	1,200	Ball Arc, Brush A. C. Incandescence.
Brockville, Ont.	105	1,000	Ball and Reliance Arc, Slattery A. C. Incandescence.
Cornwall, Ont.	....	1,300	Westinghouse A. C.
Gazette Printing Co. Montreal, Que.	....	1,350	Edison.
Halifax, N. S.	200	1,950	Thomson-Houston and Fuller Wood Arc, Slattery Incandescence.
" "	250	1,400	Thomson-Houston and Ball Arc and Westinghouse A. C. Incandescence.
Hamilton, Ont.	394	2,000	Thomson-Houston Arc, Westinghouse A. C. Incandescence
Joliette, Que	30	1,500	Thomson-Houston Arc and A. C. Incandescence.
London, Ont	100	....	Thomson-Houston.
" "	150	....	Ball.
Montreal, Que	1,440	2,000	Thomson-Houston.
Ottawa, Ont	522	....	Thomson-Houston
" "	....	4,000	Westinghouse A. C. and Weston multiple series.
Peterboro, Ont.	137	....	Thomson-Houston.
Quebec, Que.	692	1,000	Thomson-Houston.
St. Catherine's, Ont.	105	215	Thomson-Houston Arc, Weston Multiple series Incandescence
Sherbrooke, Que.	167	500	Ball and Thomson-Houston Arc and Thomson-Houston A. C. Incandescence.
St. John, N. B.	325	1,000	Thomson-Houston.
" "	205	....	Brush.
Toronto, Ont.	750	1,000	Hochhausen-Wright Arc and Thomson-Houston series Incandescence.
* " "	....	10,000	Edison.
Truro, N. S.	60	1,800	Thomson-Houston Arc, Mather Incandescence.
Valleyfield, Que.	....	1,200	Edison.
Vancouver, B. C.	100	1,150	Thomson-Houston Arc, Edison Incandescence.
Victoria, B. C.	50	1,200	Ball Arc, Edison Incandescence
Winnipeg, Man.	200	1,000	Brush and Thomson-Houston Arc, and Thomson-Houston Incandescence.
* " "	....	3,000	Edison
Yarmouth, N. S.	100	....	Fuller. Wood.

* The two stations marked thus have the nominal capacity given here, but actually run at present about 20 per cent. of the number of lights at which they are rated.

The private installations of incandescent lights in Canada, having a dynamo capacity exceeding 600 lights of 16 c. p., are :

Name of Owner.	No. of lamps 16 c. p.	System.
Canada Cotton Co., Cornwall, Ont.	1,250	Edison.
Montreal Cotton Co., Valleyfield, Que.	1,000	"
New York Life Co., Montreal, Que.	1,000	Brush.
Parliament Buildings, Ottawa, Ont	1,000	Edison.
Stormont Cotton Co., Cornwall, Ont.	850	"
Gibson Cotton Co., Marysville, N. B.	850	"
Canadian Pacific Railway Station, Montreal	800	Thomson-Houston.
Magog Print Co., Magog, Que.	700	Edison & Thomson Houston.
W. Bell & Co., Guelph, Ont.	600	Brush.

The following is a summary of the number of lights of the various systems now in operation in the Dominion :

SYSTEM.	Arc Lights.	Incandescent Lights.
Thomson-Houston	6,105	14,600
Edison	.....	23,500
Ball	3,529	1,660
Brush	615	3,300
Hochhausen (Wright's improved)	750	.....
Reliance	1,780	.....
Westinghouse	.....	6,850
Slattery	.....	5,850
Craig	.....	4,515
Mather	.....	3,125
Weston	180	5,365
Fuller Wood	425	.....
Other systems	150	1,500

Cool Air in Theatres.

Mr. Theodore Moss, proprietor of the Star Theatre, corner of Broadway and 13th street, after considering various plans for cooling the auditorium of the theatre during the performances in the summer months, has adopted the plan submitted by the Crocker-Wheeler Electric Motor Company, of 14th and Washington streets.

A trial of the apparatus on Monday, May 12, demonstrated the success of the plant, and the patrons of the theatre during the warm weather will find the temperature as pleasant as may be found at Newport, no matter what may be the heat in the streets.

The plant consists of a large Crocker-Wheeler electric motor and an immense pressure blower; an ice chamber of tremendous proportions, various ducts leading to the auditorium, and numerous registers, for controlling the flow of air.

One of the peculiarities of the system is the construction of the ice chamber, which is so arranged that the drippings of the water from the ice are utilized to cool the air before it comes in contact with the ice itself.

The system will keep the atmosphere of the theatre in a delightful condition, even without the use of ice. It is proposed to use ice only in extremely hot weather.

It is suggested that this is but the foundation of a system by which cool air will be delivered into houses throughout cities and towns, as we now receive our water, our light, our gas, and our heat. When the several small electric fan motors ordered by Mr. Moss (and which are a part of the system) are placed in position, the plant will be complete as designed by Mr. McCoubray, secretary of the Crocker-Wheeler Company.

The Comparative Cost of Storage Batteries and Horses in Street-Car Traction.

BY PAUL GADOT.

We have seen (pp. 321-322) that with two groups of batteries per day there is an expense for traction of 405,000 frs. in capital invested, and of 392,933 frs. annual expenditure; and that with three groups of batteries per car per day these figures become, respectively, 354,000 and 369,931. We may now continue our investigation of the cost of substituting accumulators for horses, and the comparative cost of using from one to ten sets of batteries per car per day.

FOURTH.—*Traction with four groups of accumulators per car per day.*

Number of cars —Instead of 20 cars, each traveling 100 kilometers per day, it will be necessary in this case, owing to the frequent changes of batteries, to have 21, each running 95.24 kilometers, each of the four groups of accumulators being accordingly called upon for 23.81 kilometers. With five cars in reserve, as in the previous cases, we have a total of 26 cars.

Weight of accumulators.—Our previous table of weights must be rejected here, as it was based upon a distance of 25 kilometers per group, but the formula (H) will give the true weight:

$$(P + x)\, L \times 0.005 = x, \text{ or,}$$
$$(7{,}500 \times x)\, 23.81 \times 0.005 = x.$$

Whence x, gross weight of one group of batteries = 1,014 kilograms, or $1{,}014 \times 4 = 4{,}056$ kilograms per car. And for 21 cars in service,

$4{,}056 \times 21$	85,176 kilograms,
15 per cent. in reserve	12,776 kilograms.
Whence gross weight of accumulators,	97,952 kilograms.

Which corresponds with a weight of the plates of 710 kilograms, or $710 \times 4 = 2{,}840$ per car, or for 21 cars in service,

$2{,}840 \times 21$	59,640 kilograms.
15 per cent. in reserve	8,950 kilograms.
Whence total weight of plates	68,590 kilograms

Charging the Batteries.—From (*F*) we find that each kilogram of the plates requires, in charging, a force of 11,425 kilogrammeters; therefore, for 59,640 kilograms of the plates there will be needed per day $11{,}425 \times 59{,}640 = 681{,}387{,}000$, or 2,524 h. p. hours—say 140 h. p. during 18 hours. A greater time is here given to charging the batteries, the consequent saving in motive power capital being made possible by the decreased time occupied by the batteries in traction.

It is now easy to ascertain the cost of the 13 subjects going to make up the expenditure for pure traction.

a. Salaries in station, less those charged to motive force.—For two groups of batteries, this charge was 42,600 fr. We have now about 15 per cent. less plates, but the number of changes of the plates is much larger. The differences are not self-equalizing, and we think there should be added, for the increase of labor required, 1,800 fr.; whence the annual total would be 44,400 fr.

b. Car-drivers.—Twenty-two; one more than before, since we have one more car in service; at 3,000 fr. = 66,000 fr.

c. Motive-power.—Per day, 2,524 h. p. hours at fr. .085 = 214 fr. $54 \times 365 = 78{,}307$ fr. 10 per annum.

d. Interest on storage-battery capital.—68,590 kilograms of plates at 1.25 fr., including boxes, etc., represent a capital of 85,737.50 fr., and an annual interest charge at six per cent. of 5,144.50 fr.

e. Repairs to batteries, boxes, etc., change of plates, etc., 68,590 kilograms at 0.30 fr. = 20,577 fr.

f. Deterioration of plates:

The plates in service cost..$59{,}640 \times 0.85$	= 50,694 fr.
With an average renewal twice a year..... $50{,}694 \times 2$	= 101.388 "
Deduct price of plates disused..... $59{,}640 \times 2 \times 0.20$ fr.	= 23,856 "
Leaving annual cost	77,532 "

g. Interest charge on motors and machinery in cars.—The cost of each car being 3,000 fr., twenty-six cars will cost 78,000 fr., which at six per cent. equals 4,680 fr. annual interest.

h. Repairs to same..—The extra car increases this item, likewise, to 13,000 fr.

i. Deterioration of same.—As before, we assume 20 per cent., but now on 78,000 fr. (see *g*) equals 15,600 fr.

j. Oil, waste, details in cars, at 2.50 fr. per day per car in service equals 19,162 fr. per annum.

k. Tools, may now be put at 6,300 fr.

l. Interest and deterioration in the charging dynamos, transmitters, belting, etc., in the station.—There will be about 112 electric horse power at 200 fr. per horse power, equal to 22,400 fr.; at 25 per cent. per annum for interest, deterioration, repairs, etc., equals 5,600 fr.

m. Various charges, 10,500 fr.

Recapitulation of annual expense for pure traction with four groups of batteries per car per day.

	Francs.
a. Salaries in station	44,400.00
b. Car-drivers	66,000.00
c. Motive power for charging	78,307.10
d. Interest on capital in batteries	5,144.50
e. Repairs to batteries	20,477,00
f. Deterioration of plates	77,532.00
g. Interest on car motors and machinery	4,680.00
h. Repairs " " "	13,000.00
i. Deterioration in " "	15,600.00
j. Oil, waste, etc., on cars	19,162.00
k. Maintenance, etc., of tools, etc	6,300.00
l. Interest, deterioration, repairs, to charging dynamos, transmitters, belts, etc	5,600.00
m. Various	10,500.00
Total	366,803.10

The total distance traversed by all the cars being 730,000 kilometers, the price of pure traction per car per kilometer comes to .502 franc; and the difference between the cost in this and the previous case is hardly appreciable.

As we have done in the other cases, we now approximate the capital necessary to introduce this system :

	Francs
Engines and boilers, 140 h p, at 750 francs	105,000.00
Dynamos for charging, transmitters, etc	22,400.00
Fitting up station, construction, etc	18,000.00
Storage batteries	85,737.50
Alteration of cars	78,000.00
Tools, etc	6,300.00
Extras	21,562.50
Total	337,000.00

Or say $\frac{337{,}000}{21} = 16{,}048$ francs per car in service.

FIFTH.—*Traction with five groups per car per day.*

Number of cars.—There will be a further increase of cars (twenty-two in service plus five in reserve = 27 total), owing to the frequent changes of batteries. Each car in service will, therefore, run 91 kilometres instead of 100, and each group of batteries will be called on for 18.2 kilometres.

Weight of Accumulators.—Remembering the new distance traversed and the formula,

$$(P + x)\, L \times 0.005 = x. \qquad \text{(H)}$$
$$\text{we have } (7{,}500 + x)\, 18.2 \times 0.005 = x.$$

whence $x = 750$ kilograms, gross weight of one plate, and $750 \times 5 = 3{,}750$ kilograms per car.

And for 22 cars in service	82,500 kilograms.
Counting 15 per cent. in reserve	12,375 "
Total gross weight of accumulators	94,875 "

corresponding to a weight of the plates per car of $525 \times 5 = 2{,}625$ kilograms.

And for 22 cars	57,750 kilograms.
Reserve, 15 per cent	8,663 "
Total weight of plates	66,413 "

Charging the batteries.—The charging of each kilogram of the plates requiring (see F) a force of 11,425 kilogrammeters; for charging 57,750 kilograms of the plates in service there will be needed daily $57{,}750 \times 11{,}425 = 659{,}793{,}750$ kilogrammeters, or about 2,444 h. p. hours, say 130 h. p for 19 hours daily.

As in the previous cases we may now recapitulate the cost of our thirteen items of expense:

a. Salaries in station, less those charged to motive force.—We now have nearly 20 per cent. less plates than in the case of two groups; but the number of changes of batteries is much larger. There will be required, we estimate, two extra hands for this, thus adding to our previous 42,600 francs a charge of 3,600 francs, or making a total of 46,200 francs.

b. Car drivers.—Twenty-three instead of 21, on account of the increased number of cars, at 3,000 francs = 69,000 francs per annum.

c. Motive power used in charging: Per day, 2,444 h. p. hours at 0.085 francs = 207.40, and per annum = 75,701 francs.

d. Interest on storage battery capital: 66,413 kilograms of plates at 1.25 fr., including boxes, etc., represent a capital of 83,016.25 fr., and an annual interest charge of 4.981 fr.

e. Repairs to batteries, boxes, etc., change of plates, etc., 66,413 kilograms at 0.30 fr. = 19,923.90 fr.

f. Deterioration of plates:

The plates in service cost $57{,}750 \times 0.85$ fr. =	49,087.50 fr.
With an average renewal twice a year..... $49{,}087.50 \times 2$ =	98,175 fr.
Deduct price of plates disused.. ..... $57{,}750 \times 2 \times 0.20$ =	23,100 fr.
Leaving annual cost	75,075 fr.

g. Interest charge on motors and machinery in cars.—Twenty-seven cars, at 3,000 francs for alteration = 81,000, which at 6 per cent. = 4,860 francs per annum.

h. Repairs to same, at 500 francs per car per annum = 13,500 francs.

i. Deterioration in same, $81{,}000 \times .20 = 16{,}200$ francs.

j. Oil, waste, details in cars, at 2.50 francs per day per car in service; $22 \times 2.50 \times 365 = 20{,}075$ francs.

k. Maintenance and renewal of tools, etc., may be put at 6,600 francs.

l. Interest and deterioration in the charging dynamos, transmitters, belting, etc., in the depot. There will be about 104 electric h. p. at 200 francs per h. p. = 20,800 francs = at 25 per cent. for interest, deterioration, repairs, etc., 5,200 francs.

m. Various charges, 11,000 francs.

Recapitulation of annual expense for pure traction with five groups of batteries per car per day:

	Francs.
a. Salaries in station	46,200.00
b. Car-drivers	69,000.00
c. Motive power for charging	75,701.00
d. Interest on capital in batteries	4,981.00
e. Repairs to batteries	19,923 90
f. Deterioration of plates	75,075.00
g. Interest on car motors and machinery	4,860.00
h. Repairs " " "	13,500.00
i. Deterioration " " "	16,200.00
j Oil, waste, etc., on cars	20,075.00
k. Maintenance, etc., of tools, etc	6,600.00
l. Interest, deterioration, repairs, to charging dynamos, transmitters, belts, etc	5,200.00
m. Various	11,000.00
Total	368,315.90

The total distance traversed by all cars being 730,000 kilometers, the price per car per kilometer comes to 0.505 francs. Comparing this with the figures in the last case, we see that the difference is again very slight, but that there is now a tendency to augment the cost. We may now state approximately the capital necessary for installing battery traction with five daily groups of storage batteries per car.

	Francs.
Engines and boilers 130 h. p. at 750 francs	97,500.00
Dynamos for charging, transmitters, etc	20,800.00
Fitting up station, construction, etc	18,000.00
Storage batteries	83,016 25
Alteration of cars	81,000.00
Tools, etc	6,600.00
Extras	21,083.75
Total	328,000.00

Or $\frac{328{,}000}{22} = 14{,}909$ francs per car in service.

Since the cost of traction per car per kilometer now increases, it will be unnecessary to examine the remaining cases suggested, that is, those employing more than five groups of batteries.

(To be Continued.)

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, May 17, 1890.

The Hall Steam Pump Company, 91 Liberty street, have furnished the United States Illuminating Company with one of their special electric pumps, 6 × 10 × 6, 150 pounds pressure. The pump is working with satisfaction.

The Hine Eliminator Company, of which Mr. F. A. Hine, late of the firm of Hine & Robertson, is president, has removed to its new quarters at 40 Cortlandt street. The Hine eliminator was placed on the market about two years ago, and since that time has met with rapidly increasing demands.

De Camp & Willson, the wholesale lumber and commission merchants now located at 18 Courtlandt street, are soon to move to more commodious quarters. They make a specialty of furnishing cedar and chestnut poles for telegraph, telephone and electric light and railroad work, and invite inspection of the samples of material that they constantly keep in their office.

The American Zylonite Company, 361 Broadway, this city, are manufacturing zylonite in large quantities for insulating purposes. Besides doing their regular work, they have facilities that enable them to make up at short notice any special design that a customer may wish. They keep constantly on hand a stock of push buttons, discs and other standard goods.

The River and Rail Electric Company, Brooklyn, N. Y., held a meeting in the Trustees' room of the Brooklyn Library last week, and elected the following board of directors to serve for the ensuing year: S. B. Chittenden, Michael Chauncey, A. C. Barnes, E. Ellory, H. L. Fillebrown, George E. Ide, C. E. Bigelow, W. H. Phelps, William Main, George L. Wright and E. J. Horton.

New Method for an Endless Belt.—Mr. Henry Bramm, manager of the solid round belt department of Chas. A. Schieren & Co., of New York, has invented a new method for making an endless belt. The belt is seamless, made of one whole hide, and so stretched after making that the tension on both edges is equal. The belt is causing quite a sensation in the trade, and is receiving many tests—which, by the way, it is standing with success.

Acker & Bentz is the name of the new firm of contractors for electric wiring which has been established at 610 East Eighty-third street, this city, and 340 Broadway, Brooklyn. Both of the gentlemen who compose this firm have had wide experience in this as well as other departments of electrical work, and are thoroughly competent to render their patrons efficient and acceptable service. They will give special attention to the wiring of theatres.

The Diehl Electric Fan, in its numerous forms, as exhibited by Diehl & Co. at their handsome showrooms at 385 Broadway, is an article of great desirability and utility. Being entirely without belting or shafting, it is unique as well as ornamental in appearance. The wire connections are invisible, and it adds much to the comfort of offices, residences and all apartments where the electric current is obtainable and cool temperature and good ventilation are desirable.

The Edison Electrical Exhibit at the Lenox Lyceum, held in the interest of the New York Exchange for Woman's Work, closed with a grand concert on May 15. The entire exhibit was a complete success. Mr. A. B. De Frece, who managed the affair, received from the members of the Exchange, as a mark of their appreciation of his services, a beautiful hand-painted dinner service. Mrs De Frece also received a handsome table cover of silk and satin, hand-painted and embroidered.

The Edison Machine Works, of which Mr. J. F. Kelley, 19 Dey street, is agent, have recently secured, through Mr. White, an order for 350,000 feet of their triple braided and compounded line wire for the suburban route of the Lindell Street Railroad Company, of Chicago. The Edison Company manufacture insulated wires and cables of all kinds, and the above contract is a good sample of the scale upon which they endeavor to do business.

An Electrical Purchasing Agency or buyers' headquarters might with profit be established in this city. While there is now nothing of this sort in the city, Messrs. Blum & Co., 5 and 7 Dey street, are giving much of their attention to this business. These gentlemen have had years of experience in the electrical supply trade, and are thoroughly competent to furnish quotations and to make purchases of electrical supplies at the lowest rates.

George W. Hunt, M. E., has taken an agency of the Standard Electric Company, of Vermont, who manufacture dynamos for arc and incandescent lighting. Mr. Hunt has headquarters at 177 and 179 Broadway, and his territory includes New York city, Long Island and Eastern New York State. The 200-light incandescent plant that is to light the steamer Winthrop is being installed by him, and he has sent a 150-light dynamo to South America. Mr. Hunt's wide experience in his business assures the success of the New York agency.

The Excelsior Electric Company, 115 Broadway, have just issued a little pamphlet in which they call attention to the superiority of electric over steam power supply, and give directions for operating motors of the different classes. Like wise advertisers they do not forget to set forth the special advantages of their own motors, giving a full description of the machines, as well as filling eleven pages with testimonials to their efficiency. There is no doubt that only a small part of available matter was used in the endorsement pages, as there is a large number of these motors in use in this State and every one seems to give thorough satisfaction.

Zimdars & Hunt, formerly of Mercer street, where they suffered loss by fire a few months ago, are now located in handsome new quarters at 127 Fifth Avenue. They have the main floor and basement, each 20 × 100 feet; the offices and salesrooms are fitted up in hard wood and present a very attractive appearance. Their factory is at 52 and 54 Grove street, occupying two floors, each 50 × 100 feet—double the size of their former factory—well lighted and fully furnished with the newest machinery for turning out their goods. They manufacture electric and pneumatic bells, annunciators, burglar alarms, and all office and household specialties. They have added a new feature to their business in electric motors of special design from 1 to 20 h. p.

Domestic Platinum Mines.—In view of the prominent place that platinum has taken in the electrical manufacturing industry, and more especially because of the recent advance in its price, it is a relief to know that we are now to have the material from domestic mines. Mr. H. M. Raynor, well known as one of the oldest of manufacturers, has sold all his dies and his machinery for platinum wire drawing to Jas. Shawel & Co., 29 John street, who are now able to produce wire of any gauge. Mr. Raynor has gone into platinum mining in the West. The mines are yielding large quantities of first grade platinum. It would be well for the manufacturers of platinum goods in this country to seize this opportunity for purchasing the domestic product.

Mr. H. C. Whitney, of the Crosby Electric Company, is "hustling" in the West for the Crosby dry batteries, and the orders which he sends to the home office are exceedingly satisfactory in both number and size. Mr. C. P. Rutty has just returned from a New England trip in the interests of the same company with his grip well filled with orders. The Crosby Company are manufacturing these batteries by thousands, making them in all sizes and for all kinds of open circuit work. The testimonials that they receive speak very highly of the successful operation of these batteries, and wherever the batteries have been tried orders for good quantities have usually resulted. The main office of the company is in the *Judge* building, Sixteenth street and Fifth avenue, this city.

The Executive Committee of the Brooklyn City Railway Company recently held a meeting for the purpose of considering the matter of electrical transit, and discussed the advisability of asking the Board of Aldermen for permission to use electricity on all their lines. They have already sought this privilege on the Third avenue extension. 'The committee reached no final decision in the matter. They will meet again this week, and perhaps will then arrive at some definite conclusion. President Lewis says that should everything come out all right, the Thomson-Houston system will be used, and two power stations will be built to supply the company's eastern and southern lines; and that if other companies wish to take advantage of these stations, the change might be so arranged as to be in the nature of a joint enterprise.

Mr. J. W. Godfrey, of the New York Insulated Wire Company, 649-651 Broadway, more popularly known as the Grimshaw Wire Company, has returned home after a business trip of several months. Mr. Godfrey has established agencies for the company in the Central, Western, and Southwestern States. These agencies carry full lines of the specialties of the Grimshaw Company competition line wires, Grimshaw white core wires and cables, the well-known Grimshaw tape and special compounds, as well as B. D. braided wire for incandescent circuits. Mr. Godfrey carried off the honors in the competition bids, and secured a large contract for wires for the Lindell street (St. Louis) Railway. This contract requires the use of 350,000 feet of their competition line wires Nos. 0000 to 0, and five miles of white core Grimshaw wire No. 0000 stranded, and amounts to over $50,000. Mr. Godfrey also secured from the Detroit Electrical Light and Power Company a $25,000 order for the company's competition line wire.

The National Electric Light Manufacturing Company, of Eau Claire, Wis., has established eastern offices at 50 Broadway, New York. These offices are in charge of Mr. Z. Latshaw, a gentleman whose experience in the electric light business is well known. Mr. Latshaw was formerly connected with the Electric Accumulator Company, and lately with the United Gas Company, both of this city. The transformer and direct systems of lighting are now engaging his attention, and with its own merits and its strong backing there is little doubt that his efforts to push the business will be successful. In the few years that this company has been established the system which it operates has become very popular. Some very large plants have been installed and some are now in process of installation. They are now installing: The 1,000-light plant at Greenwich, N. Y.; the 1,000-light plant at Jenkinson, Pa., and one 300 and one 600-light direct current dynamos for the Hotel Normandie in Washington, D. C. W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, May 17, 1890.

A Good Record.—The Bristol, R. I., Gas Light Company have been running a six-inch gong bell continuously for 65 days with one cell of the new King Philip dry battery, which as yet has shown no diminution of its power.

The Eastern Electric Cable Company, Boston, manufacturers of the celebrated Clark wire, have just issued a new and attractive price list, giving formulas for wiring lamps, motors, etc. It is quite a valuable hand-book.

Inspection of Installations.—The New England Insurance Exchange has decided that the inspection of electric lighting installation shall be continued. An inspector will be elected, therefore, to succeed Captain Brophy.

An Entertaining and Instructive Lecture on "Electricity and Electric Cars" was delivered before the Parker Memorial Science Club, of Boston, on Monday evening, May 12, by Mr. F. A. Parson, Electrician of the West End railroad.

Gilbert G. McDuff, the genial Westerner representing the Whipple electrical publications of Detroit, concluded his labors in Boston on Tuesday of last week. Mr. McDuff made many friends while here, and we trust that we may see him again soon.

Mr. R. T. White, of Boston, inventor and manufacturer of street railway supplies, has completed arrangements with the Lackawanna Coal and Iron Company, of Scranton, Pa., to manufacture his channel form of girder rail: also his side-bearing form of girder rail.

West End, Boston.—A petition from the West End Company for a location for a double track on Beacon street and Chestnut Hill avenue, Ward 25, and for leave to operate cars on the track by the overhead single-trolley system, was referred to the Committee on Railroads.

The Beacon Vacuum Pump and Electric Company, owners of the Berrenberg pump, were incorporated last week. They are now looking for a manufacturing site. This company have four 16 c. p. lamps, exhausted by their pump in 10 minutes, that have been burning constantly for 1,368 hours and are apparently as good as ever.

The Johnston Electric Train Signal Company held their annual meeting in Portland, Me., last week, and re-elected the old board of directors. The following officers were elected: General B. F. Peach, president; W. C. Johnston, vice-president and general manager; Chas. E. Todd, of Boston, secretary; C. A. Troe, of Portland, clerk.

Radial Steel Trucks.—The Atlantic Works at East Boston are building radial steel trucks for the Robinson Radial Car Truck Company, and the Bemis Car Box Company, of Springfield, Mass., is engaged on 14 trucks of the same description for use on the West End Railway of Boston, under a number of open cars which are now being constructed.

Holyoke, Mass.—The Holyoke Electric Company has been organized, with a capital stock of $10,000. F. A. Wyman is president, and A. S. Palfrey, treasurer. The company is organized for the purpose of generating, distributing and selling electricity for light, heat and power, supplying the same to the inhabitants of Holyoke and vicinity.

Protection for Street Car Passengers.—The Street Railway Committee of the Massachusetts Legislature reported a bill providing that street railway cars propelled by other than horse power, shall be equipped with such guards and fenders as the railroad commissioners shall require. A fine of $50 is prescribed for neglect to so equip a car.

The Standard Electric Time Company, of New Haven, Conn., report a large and increasing sale of their improved pocket electric gauge to the telephone companies which use them for testing transmitter batteries. Among the latest to adopt them is the New York and New Jersey Telephone Company, which has recently purchased a large number.

Elevated Electric Transit for Boston.—The Legislature committee on May 15, reported a bill passed by a vote of 7 to 4 in favor of granting a charter to the West End Railway, of Boston, to build an elevated railroad. Three years is given in which to build it. Inclined planes and electric power are stipulated, and the fare must not exceed five cents. The committee reported against all other petitions for elevated roads.

Taunton, Mass.—The Taunton Electric Light Company's building was partially destroyed by fire last week. The loss is estimated at $10,000; insurance about $7,500. The fire will keep the city in darkness for a short period. As soon, however, as the insurance is adjusted the company will at once build a new plant. The machinery was considerably damaged, but two out of the six dynamos are in fair condition, and it is expected that they will be running in a few days.

Lynn, Mass.—The employés of the Thomson-Houston Company in this place are working well under the arrangement that gives them a half holiday every Saturday between April 1 and Nov. 1. The men go to work at 6:30 A. M., and think the half hour in the morning a small matter in comparison with the value of the whole of Saturday afternoon. The plan was adopted by the company at the request of the employés, and both parties are thoroughly satisfied with the results.

Holyoke, Mass.—The enterprising electrical firm of Roland J. Oakes & Co., is now located in the new quarters at 366 High street. This firm has displayed much push and energy, as well as good management, and the consequent growth of its business necessitated a removal into more commodious quarters. The increased facilities make the firm better prepared than ever before to meet the orders which are coming in from many of the large towns and cities in Massachusetts and elsewhere.

S. C. Nightingale and Childs, of Boston, report the following electric plants as having lately been fitted with their magnesia sectional covering: The Central Power Station of the West End Railway, all piping and receivers of the engine; the Narragansett Electric Light Station, Providence, R. I.; the Marble City Electric Light Company, Rutland, Vt.; the Edison Electric Illuminating Company, New Bedford, Mass.; the Edison Illuminating Company, Lawrence, Mass.; and the Worcester, Mass., Electric Light Company, parts or whole of the piping, and the engines.

The American Steel Car Wheel Company, of Boston, have now about 500 of their wheels in use on the West End railway, the first one having been in use for about six months. A very important feature is that the brake does not slide as on an iron wheel, and better traction is secured. This company have a very hearty indorsement from the Robinson Radial Car Company, stating that they used these wheels (the first steel wheels used by them) on their first radial car. The wheels have given entire satisfaction, and the Robinson Company are now using them exclusively on all of their electric radial cars. The first were put on last fall, and do not yet show any signs of wear.

The Economic Electric Company are now fully established in their new quarters at Brockton, Mass. They have built a substantial brick factory, 124 by 40 ft., with large, airy and well lighted rooms. A 150 h. p. Corliss engine furnishes the power for manufacturing, and a 50 h. p. high-speed engine is being added to test their dynamos. Their boiler and drying rooms are models for neatness and convenience. The latest improved machinery for the manufacture of lamps, dynamos, motors and carbon filaments has been purchased, and they are now beginning to turn out work. This company has an exclusive contract to use and vend the Siemens-Halske carbon filament in the United States. They now employ about 50 hands, and will probably add to this number soon. Dr. Robert Amory is president of the company, and Messrs. Clark and Hubbard are the electricians, assisted by Professor Hooper, of Tufts College, as consulting electrician, with J. H. Vinton as mechanical superintendent. L. H. H.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, May 17, 1890.

The Superior Water, Light and Power Company, of West Superior, Wis., has awarded the contract of extending the intake pipe from Superior Bay to Lake Superior to K. F. Ward & Co., of New York. The work will cost $200,000.

A New Conduit Company in St. Louis.—Articles of incorporation of the St. Louis Conduit Company, capital $250,000, were filed in the recorder's office last week. The stockholders are John M. Sellers, 900 shares, and J. C. Ewald and H. W. Bond, 800 shares each.

The Electrical Supply Company, 171 Randolph street, Chicago, are fortunate in having secured several hundred tons of copper wire with both shield brand and Habirshaw insulation, and thus are able to supply customers with the same on telegraphic notice at lowest rates.

Mr. Emroy Morford, of Minneapolis, recently had an exhibition in Chicago of several of the electric-heating devices about to be placed on the market by the Carpenter-Nevins Electro Heating Company. Among the number was a soldering iron, a tailors' goose, a flat-iron, an egg boiler and an oven.

A New Idea.—The Chicago city electrician has, by making connections with the City Hall chimney, caused a draft from the city conduits that relieves them of all gases, and prevents the manhole explosions that have been so frequent of late. Mr. Purdy, Commissioner of Public Works, recommends this plan to all underground companies.

Mr. Ernest Hoefer, The Rookery, Chicago, has secured the Western agency for the Trinidad-Heimann insulated weatherproof wires, and has already taken several good orders for the same. Mr. Hoefer is well known as the Western representative of the Bishop Gutta Percha Company's white core wires, of which he is carrying an extensive stock in Chicago.

Wires Going Underground in Chicago.—The Commissioner of Public Works has issued permits to the Chicago Telephone Company to remove its lines from poles and place them in a conduit between Polk and Twenty-second streets, on Clark street, and to the Western Union Company to run a conduit for the same purpose on Canal street, from Kinzie to Sixteenth.

George Cutter, 80 Adams street, Chicago, has secured the contract for furnishing simple braided rubber covered wire for the extensive installation to be made in the Hannah & Hogg building,

81-87 Madison street. One thousand Mather incandescent lamps will be used, and probably about thirty arc lamps. This is another indication of the desire awakened among architects and contractors for an insulation of high resistance.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$293@$297	Cumberland	$ 59@ $60
Central Union	73@ 74	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$110@$112	Chicago Edison Co	$115@$117

Julius Andrae, 225 West Water St., Milwaukee, Wis., has just issued a handsome catalogue and price list of 112 pages, showing the various lines of goods carried in stock or made to order at the factory, 165 Second St. In addition to a complete line of telegraph instruments and house goods, including the Andrae carbon battery, a full line of construction tools is illustrated, special attention being called to the Andrae Loy, a digging tool, found by practical experience to be valuable in digging post holes for pole line circuits. Incandescent fixtures, magnet and line wires are also shown, and the volume closes with an alphabetically arranged index. The house of Julius Andrae has been established for nearly thirty years, and has gained a high reputation for honorable and progressive methods.

The Great Western Electrical Supply Company is the name of the new corporation organized this week for the transaction of a general electrical supply business in Chicago and the vast territory tributary thereto. The general management of the business will be in the hands of the well-known practical expert electrician, Mr. Geo. Cutter, who has demonstrated his ability to successfully cope with commercial problems as well as those of a more technical character. Mr. Cutter has rented the five-story double building, Nos. 190 and 192 Fifth avenue, just north of Adams and but one block distant from the Rookery—practically the headquarters of the electrical interests in Chicago; has already secured five carloads of wire and a proportional amount of other construction material, and proposes to carry the largest and most complete line of electrical supplies to be found in the West.

Capt. C. F. Dunderdale, of the Westinghouse Electric Company, has just closed a contract with the Connersville (Indiana) Gas Light Manufacturing Company for a complete steam and electric light plant for that city, consisting of a Babcock & Wilcox boiler, a Rooney automatic stoker, a Westinghouse compound engine, a 750-light alternating current incandescent system for commercial lighting and a 65-arc light plant of the new alternating current arc light system for street and commercial uses. The city council, after an extended trip to various cities, as far east as Pittsburgh, and west as far as Chicago and Evanston, Ill., examining different systems offered to them, finally awarded the contract for lighting the streets with 45-arc lamps to the gas company, which offered the Westinghouse systems. The plant will be put in by the North American Construction Company. The cities of Columbus, Ind., and Oxford, O., are both lighted with this new alternating current arc system, the plants being owned by the cities.

The Knapp Electrical Works, 54 and 56 Franklin street, Chicago, had the misfortune to have its two upper floors partially destroyed by fire about 2 A. M. on Tuesday May 13. On the top floor were several thousand finely polished wood cases of various sizes, to be used in framing the Knapp needle annunciator. These were all more or less destroyed, as was also a large amount of special stock left on that floor, as well as the tools and several machines. On the third floor a large number of expensive lathes, fine tools, dies, etc., were ruined, and also a large amount of material in process of conversion into finished articles. The total loss will approximate some $6,000, which is partially covered by insurance. At the time the fire occurred Mr. Myron A. Knapp, the general manager of the company, was en route home from Hartford, Conn., and received the unwelcome news by telegram at Albany, N. Y. But with his accustomed energy Mr. Knapp now has every department of his business in running order, and stands ready to fill orders of any size for any of his specialties, either the Knapp needle annunciator, the carbon battery, bells, Perkins lamps or Grimshaw white core wires. All his extensive stock of magnet wires, and in fact all goods on the ground floor and basement were not damaged, as the fire was confined to the two upper floors. F. DEL.

WASHINGTON NOTES.

New Railway.—A bill has been introduced in Congress that has for its object the incorporation of a new street railway in this city. It authorizes the employment of either cable, horse or electric power. The line of the road is along the northern limits of the city.

A Question of Privilege.—The action of the Commissioners of the District of Columbia in entering into a contract with the Electric Heat and Power Company, of this city, some time ago, for furnishing private and public light, was made the text of an argument by ex-District Attorney Worthington, before the House Committee having in charge the District appropriation bill.

Proposed Railroad Extension.—Senator Wilson, of Maryland, has introduced a bill in the Senate, to authorize the amendment of the charter of the Georgetown and Tenleytown Electric Railroad Company, so as to permit the extension of its lines from the present terminus in Georgetown or West Washington, to Sev th and B streets, northwest. The proposed extension is through a populous part of the city, and will be over a mile long.

The U. S. Electric Light Company is engaged in laying conduits from its central station B and Fourteenth streets, out Fourteenth street to Thomas Circle and out Pennsylvania avenue to Seventeenth street, preparatory to lighting these streets with arc lights under the District appropriation bill which provides the necessary funds. Lake's glazed conduit is used, and the inventor himself is superintending the work. This company is using this conduit altogether in Washington, and it is giving entire satisfaction.

SOUTHERN NOTES.

Norfolk, Va.—A new enterprise here is the Norfolk Electrical Works, which will do electro-plating in gold, silver and nickel, and deal in electric door bells, burglar alarms, electric motors and a general line of electrical appliances. Norfolk is an excellent location for such a business, as so few enterprises of this character have thus far been inaugurated in the South. Mr. J. F. Freeman, a well-known electrical inventor of Washington, D. C., is at the head of the enterprise, and by his energy and business sagacity will build up a business of no mean proportions.

A Board of Electrical Control.—At a meeting of the City Council of Norfolk, Va., an ordinance establishing a Board of Electrical Control for that city was adopted. It provides that the board shall consist of three members—the chairman of the committee on electric lights and other electrical constructions, the city engineers and the fire department. The board shall inspect all electrical construction, and shall have absolute power over the wires, insulation, etc. It shall have power to employ a competent man, who shall be known as Superintendent of Electrical Affairs, and who shall be under and subject to the orders of the board, his salary not to exceed $1,200 a year. The ordinance describes the duties of the superintendent, and makes it unlawful for any one to stretch wires, make connection or set poles without a permit from the board. Y. N. B.

THE TELEGRAPH.

Tillamook, Ore.—The Tillamook & Astoria Telegraph and Telephone Company has been formed at this place.

The New York Telegraph Club formally opened its new club rooms at 32 Cortlandt street on Monday evening, May 19. A very pleasant reception was given in honor of the occasion, at which many of the outsiders enjoyed themselves quite as well as the members of the club.

Telegraph Returns in England.—A very gratifying increase is shown in the returns of the postal telegraph revenue for the financial year ending March 31. The receipts from the telegraph service amounted to £2,320,000. This is an increase of £240,000 over the receipts of the preceding financial year.

A New Telegraph Line.—It is said that the Western Union will build a line from Seattle to Blaine, Wash. The Great Northwestern will take it up there and carry it to Westminster and Vancouver, whence a cable will be laid to Nanaimo and a wire strung from there to Victoria. It is likely that a line will be built to Port Angeles.

The Essick Printing Telegraph Company has leased a wire from the Western Union Telegraph Company between Boston and Washington, and will give daily exhibitions of the working of their instrument. The Intercontinental Telephone Company, through James H. Howard, are negotiating for the right to use the Essick system in South America.

Flashing a Heliographic Signal 125 Miles.—The greatest achievement yet made in heliography was accomplished during practice in the Department of Arizona recently, by Lieutenant Wittenmeyer, who succeeded in signaling a message by a signal-flash 125 miles from Mount Heno, near Fort McDowell, to Mount Graham, near Fort Grant, where it was received by Captain Murray. The latter, by turning his instrument, flashed the message to Fort Huachuaca, a distance of 90 miles, making a distance of 215 miles with a single intervening station. The longest distance heretofore made with a signal flash is said to be about 70 miles.

An Important Telegraph Law.—A new law in the state of Washington provides that all telegraph companies in the state shall exchange and transmit each others messages without delay or discrimination. By it all railroads are designated "post roads." Railroad companies shall allow all telegraph and telephone companies equal privileges for transportation of men and material for construction and repairing lines. Any railroad failing to comply with the law will be liable to suit for damages in a sum not less than $1,000 or more than $5,000 for each offense, and $100 per day during the continuance thereof. Telegraph companies are placed under penalties of not more than $500 nor less than $100 for each offense.

THE TELEPHONE.

Anderson, S. C.—A telephone exchange is wanted here, and efforts will be made to establish one.

A New Telephone of very simple construction, consisting of an electrical, magnetic, and celluloid diaphragm, has recently been brought out in England. It is said that the new instrument does not infringe upon any existing patent.

Atlanta, Ga.—A new telephone exchange is to be built. A lot has been purchased at the corner of Forsyth and Poplar streets. Plans for the building are almost completed, and the work of construction will be begun in a short time. The building is to be occupied exclusively by the telephone exchange.

Pittsburgh, Pa.—The Pleasant Valley Electric Street Railway Company has just sent to the Simplex Electrical Company, of Boston, an order for 10½ miles of anti-induction wire. The wire is for use on the Pleasant Valley Company's private telephone line, and will be placed on the same poles that support the wires for its street railway. The success attained by the Simplex Company with this anti-induction wire is worthy of notice. Wherever it has been used satisfaction has resulted.

The Venezuela Telephone and Electrical Appliances Company, (Limited), is bringing out its securities in London. It is the purchaser of the franchise, etc, of the Intercontinental Company, of Boston. The Venezuela company has a capital of 70,000 £1 shares, which it issues with £70,000 5 per cent. first mortgage bonds, the latter at 85 per cent. It pays the Intercontinental Company, according to the prospectus, £55,000 of the bonds and £60,000 of the shares or the proceeds thereof.

Telephone Exhibit in Baltimore.—The American Telephone and Telegraph Company gave an interesting exhibition at the Telephone building on St. Paul Street, Baltimore, recently, to show the working of the long distance telephone. Operatic, vocal and instrumental music rendered in New York, Boston and Philadelphia, including the "Grand Duchess," from the Casino, New York city, was heard distinctly. The success of the long distance telephone is a proof that leakage and inductive effects from other electrical forces can be overcome by adopting a complete metallic circuit of strong copper wire of high conductivity.

The Telephone Trade in Foreign Countries.—The business of exporting telephones to foreign countries is one of which only those who are directly interested can form an adequate idea. The territory of every civilized country is covered by various companies who have purchased from the inventors the right to operate in certain countries. One of the most important of these companies is the Tropical American Telephone Company, Limited, who acquired their rights by direct purchase from Prof. Alexander Graham Bell, Francis Blake, Watson Anders, et al., and they stand in South America, Central America and the West Indies on practically the same footing that the American Bell Telephone Company does in the United States. In Brazil the Bell patent has been affirmed by the Supreme Court after a long litigation, and the company has full letters patent. The Tropical American Telephone Company now has the sole and exclusive right to sell, lease and use "Bell" telephones, "Blake" transmitters and all other telephonic apparatus manufactured by the American Bell Telephone Company and Western Electric Company under patents owned or controlled by it in the United States, in the entire territory of South America, Central America and West Indies, named below, and is the source of supply for telephones, transmitters, telephonic instruments and supplies to the following telephone companies already organized and doing business, viz.: The Inter-Continental Telephone Company, capital, $200,000; The Venezuela Telephone and Electrical Appliance Company, Limited, capital, $40,000; The Columbia & Panama Telegraph & Telephone Company, capital, $100,000; The Gautemala Telephone Company, capital, $50,000: The West India Telegraph and Telephone Company, capital, $150,000; The Bermuda Telephone Company, capital, $25,000; Compana Uniao Telephonica do Brazil; The Empreza das Obras Publicas do Brazil, capital, $250,000; Empreza de Telephone do Para; The Commercial Telephone Company, Limited, capital, $150,000; The Barbados Telephone Company, Limited, capital, $100,000; West Coast Telephone Company, operating in Chili, Peru, Ecuador and Bolivia, capital, $1,000,000; W. R. Grace & Co., New York; Coombs, Crosby & Eddy, New York, exclusive agents for the Argentine Republic of the Tropical American Company; Charles Brewer & Co., Boston; Walter Hime & Co., Rio de Janeiro, Brazil; Henry B. Hamel, Havana, Cuba. The following companies, organized under the Continental Telephone Company, and using Bell and Blake instruments, have the optional right to trade with this company for instruments and supplies: The United River Plate Telephone Company, Limited, capital £500,000; the Compania Electrica de Cuba, capital $250,000; the Mexican Telephone Company, capital $1,360,000; Domingo Electric Company, capital $100,000; Jose Viadurre, Porto Rico, West Indies. All applications for territory, with exclusive right to use telephones, and all orders for instruments and apparatus to be used in any of the above countries should be addressed to this company, who will do everything in their power to assist parties who are about to install telephone plants. Mr. Charles Williams, Jr., the president of the company—the largest stockholder in the Western Electric Company—is the pioneer in the telephone business, the Bell system of electrical devices having been built under his eye and largely through his energy and inventive genius. J. H. Howard, the vice-president and general manager, is well known, having been connected with the Continental Telephone Company, the Mexican Telephone Company, the Tropical American Telephone Company, since their incorporation in 1879, 1880, and 1881, respectively, while Mr. C. W. Jones, treasurer, is also extensively acquainted in both social and business circles, and is president of the N. E. National Bank. The office of the company is conveniently located at 95 Milk street, Boston, the New York branch being at 18 Cortlandt street. The Tropical American Telephone Company will resume payment of dividends on July 1 on the old basis—10 per cent. The past year has been the most prosperous the company has ever had, and dividends at this rate could be continued for some years from the present surplus. It is thought that the net earnings for the year will equal 4 per cent. on the capital at par.

THE ELECTRIC LIGHT.

Salem, N. C.—The old Moravian College is being wired for electric lights.

Crestline, O.—A demand is being made in this town for electric street lights.

Afton, Ia.—By the first of June the electric light plant will be ready for operation.

Piedmont, Ala.—Work is now in progress on an electric light plant for street illumination.

Three Rivers, Can.—The adoption of the electric light has been decided upon by the city council.

East St. Louis, Mo.—The Tuda Iron Works is to establish an incandescent electric plant of 100 lights.

The Girard, Kan., Gas and Electric Company has been incorporated. Capital stock, $25,000.

Fort Payne, Ala., has awarded to the local electric light company an 11-year contract to light the town.

Jacksonville, Ala.—Negotiations are pending for the establishment of an electric light and power plant.

Leicester, Mass.—The electric light company has put in a horizontal double turbine Rodney Hunt wheel of 40 h. p.

Morgantown, N. C.—Proposals for the erection of an electric light plant will be received by T. J. Gillam until June 1.

Brinkley, Ark.—An electric light plant will, it is stated, be erected in this place. The mayor can give information.

St. Albans, W. Va.—An electric light plant will be established. A franchise has been secured from the municipal authorities.

Pineville, Ky.—The Pine Mountain Iron and Coal Company has recently purchased both arc and incandescent equipments.

Frankfort, Ky.—An application has been made to the Legislature to charter the Central City Lighting and Power Company.

East Chattanooga, Tenn.—An electric light plant will be built and operated by a company composed of capitalists from Boston.

Anaconda, Mont.—It is reported that an electric light plant will soon be established here by the Union Pacific Railway Company.

Sylacauga, Ala.—It is likely that an electric light plant will soon be erected by the Marble City Land and Furnace Company, of this place.

Colusa, Cal.—Arrangements are being made to erect an electric light plant in this place. C. B. Ridley, of San Francisco, can furnish information.

E. G. Baker & Co., of Lowell, Mass., are putting in an electric light plant. They have already introduced the incandescent system in three stories.

Cedartown, Ga.—A New York company has been granted a franchise to erect an electric light plant in this place. J. J. Lampton can give information.

Columbus, O.—The De Sant Electric Company has been organized, and will erect an electric light plant. The company starts with a cash capital of $50,000.

Radford, Va.—The Central City Gas and Electric Company has been organized, with a capital stock of $50,000. The president is S. Heth. S. W. Barton is secretary.

The Standard Electric Company, of Vermont, has installed a 200 light plant on the steamer Winthrop, which plies between New York and Bar Harbor.

The Fond du Lac (Wis.) Electric Company has been organized. The capital stock is $50,000. J. Rodgers is president and treasurer, and F. M. Fish is secretary.

Bucksport, Me.—The electric light plant is rapidly nearing completion, and it will not be long before electricity lights up the dark corners of the streets of the town.

San Marcos, Cal.—A company has been formed under the name of the Sattillo Electric Light Company, with a capital stock of $150,000. H. M. Garwood is interested.

Albany, N. Y.—A certificate of incorporation of the Erie & Niagara Electric Light Company has been filed with the Secretary of State. The new company has a capital of $30,000.

Van Buren, Ala.—A local paper says that the people of this town are ready and anxious for electric lights, and exhorts capitalists to awaken to the opportunity for a good investment.

Rutland, Vt.—The trustees of the village have appointed an investigation committee to visit a number of large cities and ascertain which is the best system of electric lighting to adopt.

Alexander City, Ala.—It is probable that a purchase of an electric light plant, with a capacity for 400 incandescent, and 5 arc lights, will be made by Robinson & Thomas, of this place.

The Savanna, Ill., Electric Light and Power Company has been organized, with a capital of $15,000. The incorporators are: F. S. Greenleaf, William P. Rhodes and others.

St. Louis, Mo., people are talking of lighting, by electricity, both Tower Grove and Lafayette Park. They will also place arc lights on the St. Louis bridge instead of the incandescent now in use.

Revere, Mass.—The North Shore Company are to furnish the town with 175 incandescent and 15 arc lights for one year, at a cost of $16 per light for the incandescent and not exceeding $72 per light for the arc.

Youngstown, O.—The Westinghouse Electric Company has recently sold to a newly formed corporation here, a 2,250 light plant. It is intended to push the work of installation to completion with the least possible delay.

San Antonio, Tex.—The San Antonio Gas Company has purchased the property and machinery of the electric light and power company, and expects to make many improvements in both the steam and electric plants.

Medical Lake, Wash.—The asylum at this place has awarded the contract for 500 16-candle-power lamps and a dynamo for running the same, to the Edison Manufacturing Company, of Portland, Ore. The plant will cost $3,729.90.

Santa Cruz, Cal.—H. H. Clark has been elected president of the Santa Cruz Electric Light Company. J. F. Appleby, vice-president; A. P. Swanton, treasurer; F. W. Swanton, secretary and manager; C. E. Lilly, electrician.

Richmond, Va.—At a recent meeting of the city council the committee on Electric Light asked for an appropriation of $75,000 for the purpose of establishing an electric light plant. The appropriation was granted. The plant will be wired and operated by the city.

Frankfort, Ind.—During a recent storm the electric light plant here was struck by lightning, and the dynamo used for supplying power for street lighting was completely ruined. The plant was damaged to the extent of about $2,000, and the city was for a short time without light.

A new "mast arm" for street arc lights, which is said to have many advantages over those now in use, has been invented by Mr. T. E. Leahy, Chief Engineer of the East River Electric Light Company, of New York. They will be manufactured by the Thomson-Houston Company and will soon be ready for the market.

Cleveland, Ohio.—City Solicitor Brinsmade intends to enforce the underground wire ordinance. As soon as he has the needed information as to what electric light companies have not complied with the ordinance, he will commence mandamus proceedings against them. The wires and poles in question are in the down-town district bounded by Erie, Water, and Lake streets and the Square. The ordinance provides for a fine of from $100 to $250 a week for its violation.

New Electric Company in Cincinnati.—The Cincinnati Edison Electric Light Company, with a capital of $1,000,000, was incorporated last week in the office of the Secretary of State at Columbus, O. The incorporators are: Samuel Emerson, J. H. Rhodes, Capt. C. M. Holloway, J. Gordon Taylor, Thomas C. Pearce and Thomas C. Smith. The company will operate in the city of Cincinnati, and reserves the right to conduct its wires overhead or underground.

Laconia, N. H.—The annual meeting of the Laconia Electric Lighting Company was held here last week, and the following officers were elected: president and general manager, John F. Merrill; treasurer, C. W. Tyler; clerk, Frank H. Champlin. The directors are: James H. Tilton, John F. Merrill, Gardner Cook, Jefferson Gilbert and Dennis O'Shea. Robt. G. Riley is superintendent. The affairs of the company are in a most prosperous condition. They are now setting up a new 190 h. p. Cummer automatic engine and building a new station.

APPLICATIONS OF POWER.

Holliston, Mass.—Electric transit is being considered for this place.

Bear, Ark.—An electric concentrating plant will be erected by the Lost Louisiana Company.

Cornelia, Ga.—An electric railroad will, it is reported, soon be constructed between this place and Demarest.

Batesville, Ark.—A 20-ton electric concentrating plant will be erected by the Bonanza Zinc Mining Company.

Ridgeland, Ill.—The Cicero & Proviso Electric Motor Company have nearly completed their new power house.

Augusta, Me.—The new electric road is being graded and ties are being laid. It is expected that the line will be ready by Oct. 1.

Winthrop, Mass., will soon be supplied with electric railway facilities if the project now under consideration reaches a favorable result.

A New Electric Brake recently experimented with in England is said to have stopped a car traveling at a rate of 30 miles an hour, in a distance of less than 200 feet.

The Cairo, Ill., Electric Railway Company has been incorporated, with a capital stock of $150,000. The incorporators are J. R. Truesdale, Dudley Sheppard and R. M. Foster.

Austin, Tex.—The City Railroad Company intend laying a double track, and adding eight more miles of lines, all to be operated by electric power. Charles T. Hicks is the general manager.

Newburyport, Mass.—The Black Rocks & Salisbury Beach Railway Company have purchased the franchise of the Plum Island Street Railway Company, and will at once begin the extension and equipment of its lines.

The Woodland Avenue and West Side Railway, of Cleveland, O., is preparing a petition which will be laid before the Council in a few weeks, asking permission to string overhead wires on the company's lines.

Colorado Springs, Colo.—A company is soon to begin work on an electric railway from this place to Manitou. The road will be of great service to visitors to Pike's Peak, and the hitherto long and tedious journey will become a short and delightful one in the new electric cars.

Dover, N. H.—Ground was broken last week for the Union Electric Street Railway from Sawyer Mills, in Dover, to Salmon Falls River, in Great Falls, a distance of six miles. Poles for two miles are set, and it is expected that the work will be completed and the road in operation by July 1.

Augusta, Me.—The new electric railway from this city to Gardiner, via Hallowell and Faringdale, a distance of seven miles, will doubtless be in complete running order by July 1. The Thomson-Houston system will be used to supply power for four 30-h. p. motor cars. Three trail cars will also be used.

Cleveland, O.—The plant at the Brooklyn Street Railway Company's power house is being increased, and there is some talk of extending the Scoville avenue line to East End. Several hundred men are working on the new loop for the Broadway & Newburgh road, which comprises five miles of double track.

Proposed Extension.—The *Leader* has stirred up the people at Painesville and Ashtabula, O., to a cry for an extension of the Collamer line. Mr. Henry Everett, of the East Cleveland Railroad Company, said that such an extension will probably be made in a year or two. He also thinks that the Collinwood extension, which will soon be built, will be a good investment.

The Lowell, Mass., Electric Light Company has nearly finished putting in a new engine and generators at the station, to meet the demands of increased summer travel over the railway to Willow Dale. The engine was built by Armington & Sims, and is being put in under the direction of one of their experts. It is of 200 h. p. capacity and will be run in conjunction with the other engine used for the road, making a total capacity of about 400 h. p.

The Electric Power Business is coming into much use with the commercial and manufacturing industries of Newark, N. J. Mr. Chas. F. Beers, superintendent of the Daft power station, says that motors are rented to the aggregate of 150 h. p. Some of these motors are as far as two miles from the station, and all are under the immediate supervision of the company. The supply of horse power from the station is already large, and is increasing rapidly. Three generators of 50 h. p. each are now used, and more will soon be installed. The original power is furnished from Hewes & Phillips Corliss engines. The company is prepared to furnish motors from ½ to 50 h. p.

A Big Consolidation Effected.—After months of negotiations, all of the street railway companies of Richmond, Va., and three electric light companies were consolidated last week, and the organization of the Richmond Railway and Electric Company was effected. There were present at the meeting Messrs. George E. Fisher, Donald B. Toucey and Gibson Putzel, of New York, and Wyndham R. Meredith and Frank W. Christian, of Richmond, counsel for the company. The principal work accomplished was the election of officers and board of directors. Dr. John P. Munn, New York, was elected president; Mr. George E. Fisher, treasurer, and D. B. Toucey, secretary. The following, together with the above, compose the board of directors: D. H. Haughtaling, of New York; Gibson Putzel, and Wyndham R. Meredith. The necessary resolutions were adopted authorizing the new board to purchase the roads comprising the new company. Mr. Fisher said that there would be no change whatever in the present employés, and that the main office will virtually be in Richmond.

PERSONALS.

Mr. James Swinburne, the well-known London electrician, arrived in New York May 18.

Mr. P. B. Chaney, of the Novelty Electric Supply Company, was in Boston this week in the interest of his company.

Mr. Elmer P. Morris, of the Novelty Electric Supply Company, of Cincinnati, Ohio, was in New York this week.

Mr. C. A. Dudley, an old railroad builder of Lynn, Mass., has been awarded the supervision of the Essex Electric Railway in Salem.

Mr. Edward P. Little has accepted the superintendency of the electric light works at St. Johnsbury, Vt., vice G. C. Phillips, resigned.

Mr. W. H. McKinlock, of the Central Electric Company, of Chicago, is in New York City attending to matters pertaining to his company's business.

Mr. Patrick Gargin has resigned the superintendency of the Orange Electric Light Company, of Springfield, Mass., to take a similar position at Charlotte, N. C.

Mr. Charles R. Reynolds, late electrician for the Pinkham Electric Company, of Philadelphia, is now superintendent of the electric light station at Rockville, Conn.

Mr. James A. Derron, of the Tropical American Telephone Company, has sailed from New York for London, for the purpose of assisting in floating the new Venezuela Telephone Company.

Mr. F. M. Kimball left Boston recently for Memphis, Tenn., to install a 100-light machine to run by water power. Mr. Kimball has just completed a new laboratory for wire and battery testing.

Mr. Geo. S. Adams, general manager of the Albumural wall coating company, visited Boston last week. Mr. Adams reports sales to all electric lighting stations in Brooklyn, and nearly all in New York.

Mr. Seth H. Butler, president of the Schuyler Electric Company, of Middletown, Conn., who fell from a ladder two weeks ago and sustained serious injuries, was at last accounts in a very critical condition.

R. M. Kittson, Boston, lately with the Standard Electric Company, of Vermont, has accepted a position with the Thomson-Houston Company. He has many friends throughout the country, who wish him success in his new departure.

Mr. George T. Manson, of the Okonite Company, returned on Friday last from an extensive trip through the West. He went as far west as the Pacific Coast, and reports a large large demand for the manufactures of the Okonite Company.

Dr. Schuyler Skaats Wheeler, the well-known expert of the New York Board of Electrical Control, is to be married next Monday evening, May 26, to Miss Ella Adams Peterson, of this city. Readers of the THE ELECTRICAL WORLD will, we are sure, join us in wishing the couple long life, happiness, and all the blessings they can desire.

Mr. Chas. A. Schieren, Jr., attained his majority in the early part of this month. A reception and private dinner was held in honor of the event at the Hamilton Club, Brooklyn. As a birthday gift Mr. Schieren was presented with a large interest in the American Link Belt Company, of which Mr. Chas. A. Schieren, Sr., was the founder. Mr. Shieren, Jr., is now visiting electric light stations in various parts of New York State.

MISCELLANEOUS NOTES.

Washington, D. C.—The Columbia Phonograph Company has declared a dividend of one per cent.

Rockford, Ill.—The Rockford Electric Manufacturing Company has increased its capital stock to $100,000, and made additions to its board of directors.

World's Fair Committee.—The committee on machinery and electrical appliances for the World's Fair at Chicago has been appointed, and is as follows: D. C. Cregier, O. B. Butler, A. Nathan, Robert Nelson and C. G. Wacker.

The Michigan Fuel Company has been organized at Chicago to manufacture and supply gas, electricity, etc. The capital stock is $2,000,000. The incorporators are George B. Kidder, Thomas L. Porter and C. C. March.

A New Device.—James L. Cutler, of Piketon, O., has applied for a patent on a machine by which he claims that train despatchers can regulate signals on all the stations along the line. Mr. Cutler calls the new instrument a "telecone."

Memphis, Tenn.—The Voltaic Electrical Manufacturing and Supply Company has been incorporated, and will start an electrical supply factory. The capital stock is $1,000,000. The incorporators are J. W. Allison, R. M. Straton, R. L. Coffin, and others, all of Memphis.

A New Alarm Box.—The New Haven Clock Company will have ready for the market in about 15 days the recently patented Armstrong District Telegraph alarm boxes which they are manufacturing. The low price of these boxes is calculated to put them within the reach of even small towns; and their distinctive feature is the push system upon which they are operated.

The American Society of Mechanical Engineers held its meeting last week at the Scottish Rite Cathedral in Cincinnati, O. There was an address of welcome by Mr. E Ingalls and a reply by President Oberlin Smith. There were several very interesting papers read, treating on mechanical and electrical engineering subjects. The Eastern members arrived on a special train. The association meets twice a year, the fall meeting always being in New York City. There are over 1,100 members.

New Phonograph Company.—The State Phonograph Company, of Illinois, has been incorporated, with a capital stock of $200,000. The principal stock holders are: Edwin L. Lobdell, Granger Farwell and William Hubbard, all of Chicago, and Erastus A. Benson, of Omaha. Mr. Benson is already interested in phonograph companies in eleven States. Mr. George McCullen will manage the new company, which will operate throughout the entire state except in Cook and Lake counties, which territory is now occupied by the Chicago Central Company. Mr. Henry Douglass, the manager of the Nebraska State Telephone Company, at Omaha, says that the phonograph will eventually entirely supersede the office stenographer, but of course can never take the place of the court and newspaper stenographer.

The Jamaica International Exhibition, which is to be held in the Island of Jamaica, B. W. I., in 1891, opening in January next, will be an excellent opportunity for American manufacturers of electrical apparatus to bring their products directly to the attention of the people of the West Indies, Mexico, Central and South America, and a large space has been appropriated for American exhibits. No charge will be made for space in the exhibition buildings, nor will duties be levied on any of the exhibits unless sold in the island. The buildings and grounds will be lighted by electricity, and bids are invited by the committee for furnishing fourteen 1,200 c. p. arc lamps, 500 incandescents of 16 c. p. for lighting the buildings, fifty 1,200 c. p. arcs for the grounds; one hundred 16 c. p. incandescents for the exhibition hall; and for the kitchen, stores, etc., twenty 16 c. p. "glow" lamps. The best apparatus and satisfactory work and not the lowest tender will be the criterion with the committee. An electric railway will be one of the many electrical features of the exhibition. Full information and particulars will be furnished on application to the secretary of the committee, Thomas Amor, Stewart Building, 280 Broadway, this city.

BUSINESS NOTICES.

The Russell Electric Lamp Company, of Boston, whose disc carbon arc lamp we illustrated last week, are making three sizes of the lamp, to burn respectively 12, 18, and 24 hours.

The Connecticut Electric Motor Company have established a representative in Cincinnati, O. They are selling a motor that is handsome in appearance, noiseless in operation, and said to be very efficient. Their headquarters are at Third and Walnut streets.

The Diehl Electric Company, of New York have established an agency in Cincinnati, O. Messrs. Wadsworth & Perry, who are located in the Smith building on Walnut street, are acting as their agents. They are making a specialty of fan motors, and are meeting with success.

The Jerome Kidder Manufacturing Company: The instrument turned out to be the "ne plus ultra" I have yet had from your skillful factory establishment. It is a masterpiece of fine, accurate workmanship, and gives good satisfaction. . . .

G. W. DORP, M. D., San Francisco, Jan. 7, 1890.

The Westinghouse Electric Company has just issued an admirable catalogue setting forth the advantages of its new alternating arc light system, which is now rapidly passing into general use. Like many other of the Westinghouse catalogues, this is a model of typography, and the system is illustrated in the plainest and most complete manner.

The Newport, Ky., Electric Light Company are doing a good business. They have recently placed about 35 arc lamps on the Ohio side of the river, in the station and yards of the Pennsylvania Railroad Company. The wires are carried over the Ohio river on the bridge of the Louisville & Nashville Railroad Company. They are using the Ball arc system.

The Wenstrom Consolidated Dynamo and Motor Company is preparing to push its well-known machines in the most vigorous manner. Under its recent organization it includes some of the best-known capitalists of Baltimore, and its financial backing is such as to insure vigorous action. Chadbourne & Hazelton, as we noted last week, have full control of the Wenstrom dynamos and motors for the United States, and with their well-known business energy it is likely that the machines will become, as time goes on, more and more familiar to the public. The Wenstrom dynamo, it is hardly necessary to state, belongs to the iron-clad type, and its tests of durability have been of the most satisfactory character. At the head of the company is Mr. H. F. Parshall, well known by his connection with the Sprague motor. Mr. Parshall's connection with the new company ought to produce a feeling of confidence in it throughout the electrical fraternity.

Owing to the pressure of a few important papers on our columns this week the Patent Record is omitted.